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PERSONNEL AND EQUIPMENT DESIGN CONCEPT FOR A MARITIME PATROL AI--ETC(U)
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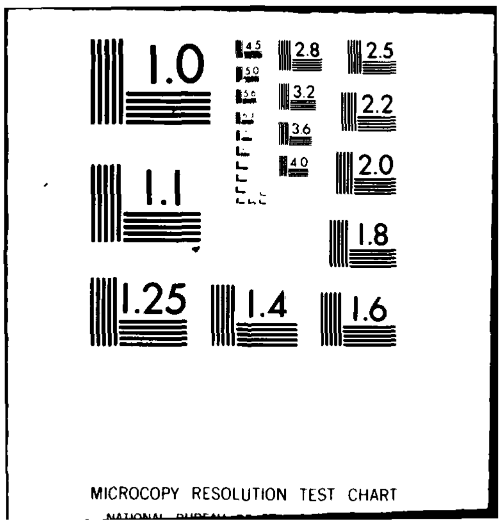
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NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

PERSONNEL AND EQUIPMENT DESIGN CONCEPT FOR A MARITIME PATROL AIRSHIP (NON-RIGID) TO CONDUCT SEARCH, ANTI-SUBMARINE WARFARE, AND AIRBORNE MINE COUNTERMEASURES MISSIONS

by

Thomas Charles John McGinlay

December 1979

Thesis Co-Advisors: J.K. Arima
W.F. Moroney

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Personnel and Equipment Design Concept For a Maritime Patrol Airship (Non-Rigid) To Conduct Search, Anti-Submarine Warfare, And Airborne Mine Countermeasures Missions

by

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Submitted in partial fulfillment of the requirements for the degree of

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ABSTRACT

A personnel and equipment design concept for a non-rigid, 100 hour endurance, Maritime Patrol Airship meeting Search and Rescue (SAR), Anti-Submarine Warfare (ASW), and Airborne Mine Countermeasures (AMCM) requirements was developed. The Maritime Patrol Airship could readily be equipped with off-the-shelf equipment. Minimal new design equipment requirements were identified. A baseline flight scenario and on station scenarios for: SAR, transoceanic ASW utilizing a passive towed array sonar, and AMCM were developed. Human factors task analyses and a time line analysis were constructed from the scenarios. Manning reductions resulted for each scenario (3 crewmembers for SAR, 10 crewmembers for transoceanic ASW, 7 crewmembers for AMCM). Further research areas are identified.

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LIST OF ABBREVIATIONS

AS	airship
A/S	airspeed
AIFR	airship-in-flight-refueling
AIMS	Air traffic control radar beacon system/IFF/Mark XII identification system/System
ALT	altitude
AOA	angle of attack
APP	approach
APU	auxiliary power unit
ASAC	ASW air controller
AUX	auxiliary
BCN	beacon
BT	bathythermograph
BTR	bearing time recorder
CB	circuit breaker
CC	crew chief
CDP	computer control and display panel
CK	cook ("rigger" is the more appropriate term in airship terminology)
CM1	crewman one
CM2	crewman two
CM3	crewman three
CM4	crewman four
CN	communicator/navigator
CPC	central processing computer

DVARS	doppler velocity altimeter radar set
ECS	external communications set
FDS	flight director system
FLAR	forward looking radar
FLT	flight
GCA	ground controlled approach
HF	high frequency
HP	horsepower
HSI	horizontal situation indicator
IAIRTASS	Interim Airborne Towed Array Sonar System
ICS	interior communications system
IFF	identification friend or foe
KTS	knots
LSE	landing signal petty officer
MAD	magnetic anomaly detection
MON	monitor
OPS	operations
P	pilot
PA	public address system
PSI	pounds per square inch
RAWS	radar altitude warning system
R/C	rate of climb
RPM	revolutions per minute
SAR	search and rescue
SCRN CDR	screen commander
SHP	shaft horsepower

SLAR	side looking radar
SOP	standard operating procedure
SS1	sensor station one operator
TACH	tachometer
TASS	towed array sonar system
TIT	transponder interrogation transceiver
UHF	ultra high frequency
VHF	very high frequency
VOR	VHF omni range
WT	weight
YELLOW SHEET	OPNAV Form 3760/2 Naval Aircraft Flight Record

In Memory Of

Kapitänleutnant Heinrich Mathy, Imperial German Navy

and

Fregattenkapitän Peter Strasser, Imperial German Navy

the heart and soul of the German Naval Airship Division

and

pioneers of military airships.

- LUFTSCHIFF VORAUS! -

I. RELEVANCE OF AIRSHIPS

Mention of the word "airship" usually evokes in the minds of many the image of tragic failure. The flaming destruction of the HINDENBURG is etched in the imagination even of those born long after the demise of DELAG.[1] At best the word "airship" conjures up the picture of the Goodyear blimp at the Super Bowl. Can anyone be seriously interested in bringing back airships?

The answer to that question is twofold. First of all the question is badly put because airships have never "gone away." The Goodyear Tire and Rubber Company of Akron, Ohio has been active in the manufacture and operation of both rigid and non-rigid airships since the First World War. Secondly serious interest has been shown during the past five years in the use of modern airships to solve current problems.

A. U.S. COAST GUARD INTEREST

The U.S. Coast Guard is presently investigating the possible development of a modern, hover-capable, maritime patrol airship (MPAS). As a result of the establishment of a 200 mile limit fishing zone several years ago, the surveillance area for which the Coast Guard was responsible grew enormously.

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[1]Deutsche Luftschiffarts Aktiengesellschaft - The German Airship Navigation Company, Inc., the operators of the airships GRAF ZEPPELIN and HINDENBURG.

During the same period, the increase in drug smuggling, especially in the western Caribbean between Colombia and the Florida and Gulf coasts, vastly outstripped the assets available to the Coast Guard. Disregarding for the moment the ever-present budgetary problems of procuring large numbers of ships and aircraft, the enormous rise in fuel costs made the problem even more difficult. The known capability of airships to conduct ocean surveillance with extremely long endurance and fuel efficiency would have evoked interest of itself. However the additional capability of true hover made possible by directable thrust fan engine technology made the concept of a modern maritime patrol airship very interesting. It melds the best features of a helicopter with the capabilities of a habitable, long endurance surveillance platform.

Goodyear Aerospace Corporation has prepared a conceptual design for a modern maritime patrol airship at the request of the Naval Air Development Center [Goodyear Report, 1979]. Figures 1 and 2, and Tables 1 and 2, which are reproduced from the Goodyear Report, provide a summary of the capabilities of the general design. This design was developed to fulfill eight Coast Guard missions. Seven of these missions are Coast Guard peacetime missions. The eighth is an anti-submarine warfare (ASW) mission, requested by the Coast Guard in fulfillment of their wartime role of conducting naval warfare under Navy command.

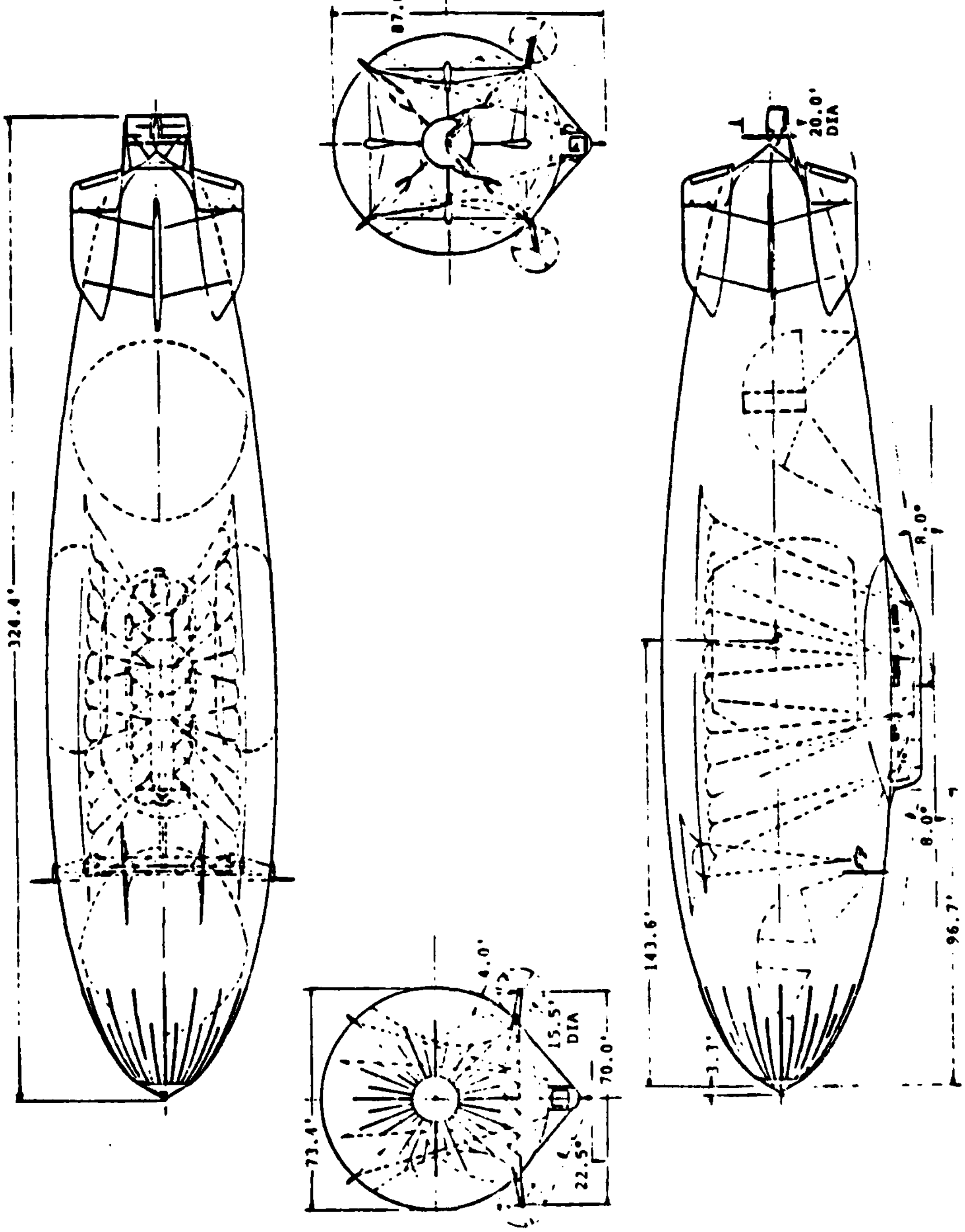


FIGURE 1 ZP3G AIRSHIP

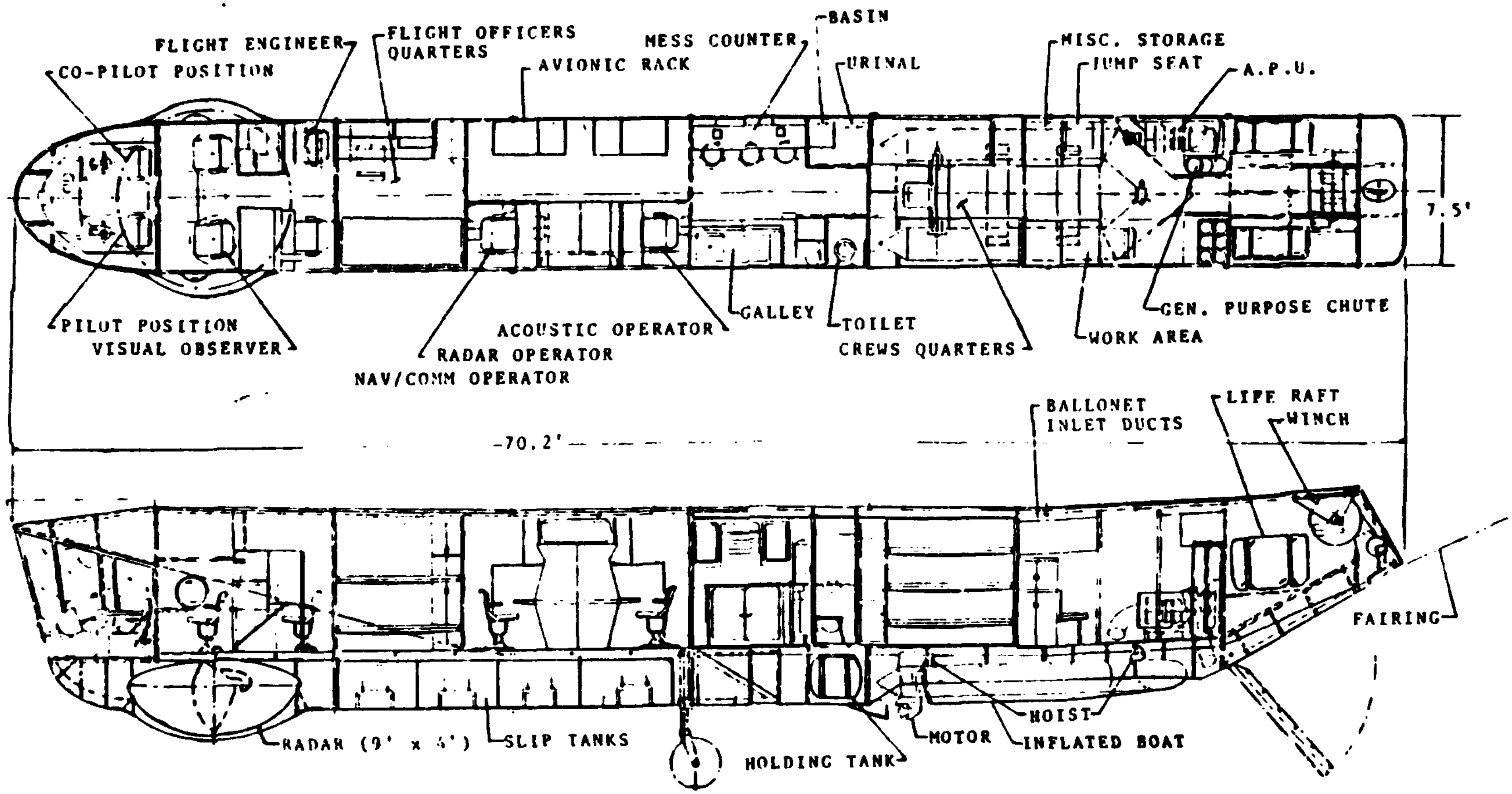


Figure 2 Inboard Profile

TABLE 1

MAJOR CHARACTERISTICS

Envelope Volume	875,000 Cu Ft
Ballonet Volume	216,250 Cu Ft
Fineness Ratio	4.40
Beta Factor	.86
Static Lift @ 2000 Ft Altitude	52,164 Lb
Dynamic Lift	8,500 Lb
Maximum Gross Weight	60,664 Lb
Weight Empty including Fixed Mission Payload	38,160 Lb
Useful Load	22,504 Lb
Power Plant	
[3] Allison GMA-500	800 Shp Ea.

TABLE 2

ZP3G PERFORMANCE SUMMARY

MAXIMUM SPEED (8500 LB HEAVY)	94 KNOTS
MAXIMUM SPEED (8500 LB HEAVY, REAR ENGINE ONLY) (MAXIMUM CONTINUOUS POWER)	52 KNOTS
MAXIMUM SPEED (NEUTRALLY BUOYANT)	97 KNOTS
RANGE @ 40 KNOTS $\geq$	3407 N.M.
RANGE @ 50 KNOTS $\geq$	3290 N.M.
BEST CLIMB VELOCITY	71 KNOTS
RATE OF CLIMB AT MAXIMUM POWER	3375 FT/MIN.
RATE OF CLIMB LIMITED BY AIR SYSTEM	2400 FT/MIN.
CONVENTIONAL TAKE-OFF DISTANCE (8500 LB HEAVY)	1025 FT.
VELOCITY @ LIFT-OFF	50 KN
DISTANCE TO CLEAR 50 FT OBJECT	2400 FT.
VELOCITY @ CLEARANCE HEIGHT	65 KN
TIME TO ACCELERATE TO 40 KNOTS (NEUTRALLY BUOYANT)	15 SEC.
TIME TO ACCELERATE TO 92 KNOTS (95% MAXIMUM SPEED, NEUTRALLY BUOYANT)	64 SEC.
TIME TO DECELERATE FROM 97 KNOTS TO 0 (NEUTRALLY BUOYANT)	55 SEC.
ALTITUDE LIMIT	5000 FT.
BALLONET CEILING	9700 FT.
ENDURANCE $\geq$ 25 KNOTS	101 HRS.

The Coast Guard has not been alone in its interest in lighter-than-air (LTA) vehicles. The Senate Subcommittee on Science, Technology, and Space held hearings in February and March, 1979 on lighter-than-air vehicles [U.S. Congress, Propelled Lighter-Than-Air Vehicles Hearings, 1979]. During these hearings testimony was taken not only concerning a potential Coast Guard maritime patrol airship but also concerning an airship designed for the transport of heavy, indivisible loads and other possible uses for lighter-than-air technology. The subcommittee members, especially Senator Goldwater (R, Arizona), were very interested in the possibility of a resurgence of lighter-than-air vehicles.

This interest has been translated into concrete action. In June, 1979 the Senate Committee on Commerce, Science, and Technology, recalling the testimony given in the February and March hearings on airships, directed the National Aeronautics and Space Administration (NASA) to request funds for construction of a flight research airship in the fiscal year 1981 budget or the fiscal year 1982 budget at the latest. The purpose of this vehicle is to conduct research into the use of airships for heavy object lifts and for patrol, rescue, and reconnaissance purposes [U.S. Congress, NASA Authorization, 1979, p. 24].

The Coast Guard is currently engaged in efforts to lease a hover capable airship for initial feasibility tests. In the opinion of Rear Admiral A.P. Manning, Jr., the Coast Guard Chief of Research and Development, the limit of what

can be accomplished by paper studies has just about been reached [U.S. Congress, Propelled Lighter-Than-Air Vehicles Hearings, 1979, p. 4]. The volume of paper studies is indeed remarkable for a technology that some presume to be archaic. As an indication, there have been 104 technical papers presented at AIAA (American Institute of Aeronautics and Astronautics) biannual Lighter-Than-Air conferences since their initiation in 1975 [Vittek, 1975; American Institute of Aeronautics and Astronautics, 1977; American Institute of Aeronautics and Astronautics, 1979].

B. OF WHAT USE TO THE NAVY?

Certainly the activities of the Coast Guard are of interest to the Navy community purely from the aspect of mutual professional knowledge. However, the fact that the Coast Guard sees possible merit in some technology is not adequate justification for the Navy to involve itself. After all, the missions of the Coast Guard are not the same as the missions of the Navy.

The potential that is inherent in a hover capable, nonrigid airship may provide the Navy with an economical platform to significantly improve Navy capabilities in at least two important missions: passive ASW coverage for non-CV task groups/convoys and airborne mine countermeasures (AMCM).

1. Passive ASW Protection

The most recent emphasis in ASW has been toward passive acoustical detection using towed linear arrays.

Passive ASW provides target detection at greater ranges and avoids providing the enemy submarine with information about the location of the friendly force that is inherent in active sonar transmissions from surface ships.

The hover capable airship is ideally suited as a platform to operate TASS (towed acoustical sensor system). It can deploy and recover the array in high sea states while motionless. It can tow at slow speeds for extremely long periods. It minimizes the introduction of self noise into the acoustical medium in the vicinity of the array. This is an unavoidable degradation inherent in both surface ship and submarine tow platforms. Best of all, the airship, with sprint speeds of 90 kts., is able to outperform even high speed nuclear submarine tow platforms in moving from one ASW station to the next.

Platforms on which to mount the TASS are in critically short supply. Only a few surface combatants are so equipped. Those SSNs which are TASS configured are badly needed for missions other than direct support. Helicopters can tow TASS, but their extremely low endurance makes this infeasible. Fixed wing ASW aircraft (P-3s and S-3s) cannot tow.

2. <u>AMCM</u>

Mine countermeasures platforms are also in critically short supply, and again the hover capable airship far surpasses the existing platforms in capabilities. The Navy's present mine countermeasures assets consist of one squadron

of aged MSOs and three squadrons of RH-53D helicopters. The airship could operate the AMCM gear which was developed for the RH-53 helicopters with little or no modification. The RH-53D has only a two hour mission time. The maritime patrol airship design proposed in the Goodyear Report (1979) has an endurance of 101 hours. In addition, the inclusion of a computer driven automatic control and navigation system, similar to the 10-year-old proven system described later in this work, would enable the airship to conduct sweeping operations with precision accuracy.

C. FOREIGN INTEREST

Serious interest in modern airships is not unique to the United States by any means. Glover [1979, pp. 14-15] has outlined ongoing lighter-than-air activities in Great Britain, France, Japan, the U.S.S.R., and Canada. In addition, the Venezuelan company Aerovision has placed an order with a British company, Aerospace Developments Ltd., for a modern, hover capable non-rigid airship.

D. CONSIDERATIONS ON THE QUESTION OF NAVY USE OF AIRSHIPS

The Navy discontinued the use of airships in the early 1960s. There would have to be strong reasons to argue in favor of resuming LTA in the Navy. In this section the causes which led to the decision to discontinue the Navy LTA program will be examined in the light of subsequent technological development.

1. Fuel

The economic results of the policies of the OPEC oil cartel have been to escalate the costs of fuel astronomically. Although it is not possible to predict future developments in OPEC policies, it is doubtful that fuel costs will go down in the forseeable future. Flanigan [1978, pp. 14-15] calculates that fuel consumption for a large rigid airship is about 31% of the fuel which would be required for equivalent P-3 operations.

2. Endurance

Non-rigid airships have tremendously greater endurance than heavier-than-air platforms. In March 1957 a Navy ZPG-2 non-rigid airship commanded by CDR J.R. Hunt, USN flew from South Weymouth, Massachusetts to Portugal, down to the Azores, back across the Atlantic to Puerto Rico, thence to Cuba, and landed at Key West, Florida. This flight was non-stop, with no refueling enroute [Commanding Officer, U.S. Naval Air Development Unit, 1957]. The purpose of this two hundred and sixty-five (265) hour flight was to demonstrate trans-oceanic airship surveillance capabilities with an endurance record as a secondary goal. As a result the first leg of the flight to Portugal was conducted in a fully operational mode.

It is estimated by Flanigan [1978, p. 30] that the use of modern materials in airship fabrication could result in a 42% weight reduction in gross airship weight. The long

endurance of an airship, already a proven fact, is a capability that promises even more growth.

3. Passive vs. Active ASW

The technology and tactics which were developing in the late 1950s and early 1960s favored active sonars for surface and air ASW platforms. Although used extensively by the submarine ASW community, passive sonar had only a minor role in surface and air ASW. Airborne ASW platforms also began to rely more and more heavily on sonobuoys laid in fields, sometimes widely separated. In such an environment fixed wing and helicopter platforms capable of rapidly laying sonobuoy fields or sprinting to investigate possible contacts clearly were more desirable than airships for ASW operations.

However the current trend in ASW technology is toward towed linear passive sonar arrays which provide increased detection at much greater ranges than either active sonars or single passive sonobuoys. As discussed by Flanigan [1978, p. 17], although TASS technology provides a tremendous advantage over air launched sonobuoys the Navy presently does not have a good tow platform. Fixed wing aircraft cannot tow TASS. Helicopters can, but their short endurance renders it infeasible. Surface ASW ships can and do tow TASS. However an unavoidable problem with this is the introduction of ship's self noise (propellor and machinery noise transmitted through the hull). The probability of counterdetection by enemy submarines is high. Submarines are also capable of towing TASS,

but here again the problem of the ship's self noise is unavoidable. Moreover the unit cost of frigates, destroyers, and submarines prevents their availability in the numbers required for ASW missions.

4. Ground Handling Crews

One of the principal factors which led to the disestablishment of LTA in the Navy was the manpower intensive system of ground handling. Shifts to capital investment were slow since manpower was relatively cheap. Although the Navy had pioneered in the development of mooring masts in the 1920s, Navy blimps still required 15 to 20 ground handlers during launch or landing operations. This problem was finally solved by the development of ground handling "mules" in the late 1950s. These tractor-like vehicles had wheels which were rotatable 90 degrees and a constant tension winch. By use of a "mule" the ground handling crew was reduced to six persons. Unfortunately the decision to discontinue LTA had already been made when this technology was developed and made operational.

5. Maneuverability

Although the airship had always been capable of extremely slow speed operations and, under certain conditions, vertical take off and landing, precision hovering had not been possible unless heading directly into the wind. Improved aircraft engine technology (ducted, rotatable fan engines) has now added this capability to the airship. Such technology has been installed and successfully operated in England by

Aerospace Developments, Ltd., in 1979 on their non-rigid airship, the AD-500 [Naylor, 1979]. Additionally sprint speeds of 97 kts. are feasible (see Table 2). These capabilities now provide the hover airship with comparable maneuverability to helicopters.

6. <u>All Weather Capability</u>

There is no all weather capable air or surface platform. Even battleships have suffered major structural damage due to weather. The appropriate question therefore is how much will a platform be limited by weather conditions. In the case of the airship the answer is that weather does not significantly hinder operations. The weather data in Table 3 were developed by the Coast Guard and presented in Senate testimony [U.S. Congress, LTA Hearings, 1979, pp. 8-9]. Table 3A presents the estimated limiting conditions imposed by weather on airship operations. Then in Table 3B in tabular form the percent of the time that airship flight operations would be so limited in 15 geographical locations is given.

The Navy conducted tests with airships to determine their weather imposed limitations in 1957.

> ...evaluation trials in bad weather had to be carried out. For eleven days in January, 1957, ZPG ships from South Weymouth, operating in relays, maintained continuous patrol 200 miles east of the New England coast. January on the North Atlantic is notorious for really bad weather and this particular January was only an exception to the rule in that the storms were some of the worst experienced in the area for many years. The trials were completely successful. [Clarke, 1961, p. 163]

Table 3A

Estimated Weather Limits for a Conceptual
90 Knot Modern Maritime Patrol Airship with Vectored Thrust

Condition	Limit*	Table 3 Column
Landing Visibility/Ceiling	- 1/4 n. mile/150 feet	2
Take-off Visibility/ Ceiling	- 100 yards/150 feet	3
Ground Handling	- 33 knots	4
On-Scene Low Level Operations (visual inspections, boarding-recovery)	- 8 foot seas	9
	1/2 n. mile/300 feet	1
On-scene Mid-level Operations (Radar Search Patrol - Sensor-based Surveillance - Occasional very high priority with close-in visual inspections) (2,000-5,000 feet nominal operating altitude)	- 50 yards/150 feet	3

Data in the columns of Table 3A represent the percentage of time that the above estimated weather limits will be exceeded based on historical weather occurrences.

* Under conditions of extreme emergency, limiting conditions can be exceeded at judgemental discretion of operator.

Table 3B

Annual Synoptic Weather Data

Source: Naval Weather Service Command "Summary of Synoptic Meteorological Observations North American Coastal Marine Areas"

Name	Location Long.	Lat.	1 Visibility/Ceiling < 1/2 mi < 300 ft %	2 Visibility/Ceiling < 1/4 mi < 150 ft %	3 Visibility/Ceiling < 50 yds <150 ft %***	4 Wind >33 kt %	5 Wind >41 kt %	6 Predominant Wind Direction	6 %	7 Mean Wind Speed (kt)	8 Sea Height >23 ft %	9 Sea Height >8 ft %
Argentina	45-47N	43-56W	13.8	12.4	12.3*	5.3	1.6	W	22.0	16.2	.5	19.
Boston	42N-Coast	66W-Coast	7.2	6.3**	5.6	3.0	.8	NW	16.8	14.2	.1	8.
New York	40N-Coast	72W-Coast	4.9	4.4**	4.2	1.6	.4	NW	14.7	12.2	.1	3.
Cape Hatteras	34-36N	75W-Coast	1.6	1.4**	1.2	2.7	.7	N	17.3	15.0	.2	11.
Miami	25-29N	78-81W	.7	.5	.5	.6	.1	N	21.7	11.9	0	5.
Guantanamo	18-20N	74-76W	.3	.2	.2	.2	0	NW	32.1	10.8	0	6.
Pensacola	27N-Coast	86-89W	.8	.5	.5	.5	.1	NW	13.9	11.7	0	5.
New Orleans	27N-Coast	89-92W	1.0	.7	.6	.6	.1	NW	14.2	11.8	0	5.
Corpus Christi	26N-Coast	95W-Coast	1.4	1.0	1.0	.8	.1	N	16.7	12.7	0	4.
San Diego	31-34N	Coast-120W	2.2	1.9	1.9	.2	0	NW	32.1	9.7	0	2.
San Francisco	36-38N	Coast-126W	4.7	3.9	3.8	1.7	.3	NW	46.1	14.2	.1	14.
Eureka	40-42N	Coast-127W	8.8	7.9	7.8	3.3	.7	N	31.5	15.2	.4	16.
Astoria	46-48N	Coast-127W	4.0	3.2	3.1	2.6	.7	NW	22.0	13.1	0	14.
Kodiak	56N-Coast	151-157W	6.3	5.6	5.5	4.6	1.2	SW	14.8	13.0	.1	12.
Adak	51-55N	172-180W	15.4	14.6	13.3	5.0	1.7	SE	16.3	15.2	.6	22.

*Visibility >55 yd, <1/2 mi.

**Interpolation

***Approximates <100 yds/<150 ft.

Data in the above columns represent the percentage of time that estimated weather limits will be exceeded based on reported historical weather occurrences.

+Taken from ONR memo 4C-28 Summit Research, Inc.

In many situations Navy airships performed under more adverse weather conditions than heavier-than-air Navy air platforms. The following account given by Captain M.H. Eppes, USN, Commander Fleet Airship Wing ONE is illustrative:

> Yet high winds in themselves are not dangerous to airship operation; the ship flies just as well in gale winds as it does in a flat calm. Obviously, though, the force and direction of the wind play an important part in the plans of an airship commander. There will be occasions where strong winds can limit his freedom of action but, quite frequently, he will be able to use the winds to his own advantage. He must be constantly alert to those conditions and make his plans accordingly.
>
> An example of just such a situation occurred during a recent exercise. An ASW airship from Key West was operating with a carrier task group several hundred miles to the east of Jacksonville, Florida, when an unexpected low pressure centre blew into the area. The blimp had refuelled in flight as necessary and had been with the task group continuously for over 40 hours (of a scheduled 100-hour operation) when the storm hit. During the next 18 hours winds were continuous at 35 knots or greater with seas so rough that flight operations were suspended on the carrier and the surface ships were forced to slow and head into the wind. During this period the blimp remained with the task group and provided the only air coverage that was possible under the circumstances. [Eppes, Note 1]

This is not to say that there have not been serious problems in which weather was a factor. The Navy rigid airship USS AKRON was lost off Barnegat Light, New Jersey on April 4, 1933 with 73 men including Rear Admiral William A. Moffett, USN, Chief of the Bureau of Aeronautics. AKRON flew into a low pressure front and was considerably closer to the water than her navigator realized. Attempting to climb, the stern of the giant airship struck the water. The

cause of the disaster, however, was not the weather, per se. The actual cause was the state of the art in altimeters. At the time only barometric altimeters were available. Obviously changes in ambient barometric pressure can cause false readings on such an instrument. Such a problem would not exist with radar altimeters currently in the Navy inventory.

Airships enjoy a tremendous advantage over heavier-than-air platforms in low visibility conditions. Due to their ability to take off and land at extremely slow speeds or vertically if need be, airships can operate under visibility conditions which ground heavier-than-air platforms.

7. VERTREP and COD

From what has already been said, it is clear that airships are also capable of VERTREP (vertical replenishment of a surface vessel) and COD (carrier on board delivery of mail and stores). These areas are beyond the scope of this work but are mentioned here as other considerations which bear upon the question of the versatility of this platform and its potential for reactivation in naval operations.

E. SPECIFIC RECOMMENDATIONS FOR NAVY USE

As has already been stated, the Coast Guard provided eight missions as parameters for the design concept developed by Goodyear [Goodyear Report, 1979]. The mission designed for a naval wartime role is entitled MO/MP (Military Operations/Military Preparedness). This mission profile is reproduced here as Table 4.

Table 4

MO MISSION PROFILE

MO/MP: Towed Array ASW, Attack		[27.5 Hrs] Hrs
1.	Warm-up, take-off @ S.L. TOGW Standard day [T = 59° F]	.25
2.	Climb to Alt = 5000 Ft	0
3.	Cruise 300 nm @ 40 kn	7.5
4.	Descent to Alt = 500 Ft	0
5.	Tow array @ 10 kn 2300 Lbs Drag	.5
6.	Cruise 15 nm @ 30 kn 1200 Lbs Drag	.5
7.	Repeat Steps #5-7 fourteen times	14.0
8.	Dash @ 90 kn for 1 Hr	1.0
9.	Attack [deploy weapons]	0
10.	Cruise 100 nm @ 40 kn	2.5
11.	Descend and land @ S.L. with 10% fuel remaining	.25

MO/MP: Mission Payload		Lbs
1.	Crew of 11 [@ 200 lbs/man]	2200
2.	Provisions, General Stores and Potable water [@ 25 lbs/man-day]	315
3.	Rescue Equipment	81
4.	Towed Array System [including processor]	1500
5.	MK-46 NT [3]	1524
6.	VLA/DIFAR [Dwarf] [20]	200
7.	Marker, BT; AN	300
8.	MAD Gear	400
	TOTAL	6520

In addition to analyzing the Coast Guard SAR mission, this thesis presents an expansion of the MO/MP mission profile as a proposal for potential Navy utilization of the maritime patrol airship. This expansion was done in two parts. One part of the expansion analyzes the use of the maritime patrol airship as an airborne mine countermeasures platform. The other part analyzes a more ambitious ASW role for the airship.

The expanded ASW mission envisions use of the airship as an integral element of a transoceanic ASW screen protecting an escorted merchant convoy or a naval task group with no aircraft carrier present. It is proposed to operate three or more airships towing IAIRTASS (Interim Airborne Towed Array Sonar System) from 20 nautical miles ahead to 8 nautical miles astern of the main body. The IAIRTASS would be towed at depths to 300 feet 24 hours a day. The airships would use sprint and drift tactics. Airships would sequentially sprint ahead of the main body and then drift until the main body passed ahead. The operability of the IAIRTASS has already been demonstrated in tests conducted by the Naval Air Development Center, Warminster, Pennsylvania in the early 1970s.

It is not intended to design the airship as a tactically independent ASW unit. The airship would have the capability to tow the IAIRTASS and provide passive detection. All plotting, command and control functions would remain on board

one of the surface escorts. This serves to retain these functions on board the platform where the screen commander is embarked and also minimizes manpower requirements on the airship. Similarly the airship would have the capability to localize and attack a submarine. However this capability is envisioned only as a back-up system. The LAMPS helicopter should be utilized for localization and attack since this is LAMPS' primary purpose.

Transoceanic task group or convoy protection involves in-flight refueling and reprovisioning of the airship. These are capabilities that were developed and proven by Navy non-rigid airships of the post World War II period. Any escort vessel that is capable of in-flight refueling a helicopter would be capable of in-flight refueling a non-rigid airship.

An extremely important consideration is the vulnerability and survivability of airships. Flanigan [1978, pp. 17-18] raised this question but did not deal with it at great length. He proposed arming the airship with the Harpoon and Phoenix weapon system [Flanigan, 1978, pp. 49-50]. The airship Flanigan was considering was a rigid. A non-rigid airship is too small to carry weapon systems of such weight.

In any question of vulnerability it is necessary to ask how vulnerable is the system in a specific scenario? For example, an Air Force C-141A jet transport operating between Charleston, South Carolina and Frankfurt, Germany in 1979 is fairly safe. To operate the same aircraft over an enemy

fighter base in war would almost certainly result in loss of the aircraft. In the modern naval warfare scenario any air or surface platform is vulnerable to attack from enemy air and surface platforms. All of our current ASW air assets are vulnerable if attacked by enemy air or surface platforms. Presently submarines do not have the capability to attack air platforms. Therefore the answer to the question of vulnerability of ASW airships is that like all ASW air platforms they are presently immune from submarine attack and vulnerable to attack by enemy surface and air units. It is the responsibility of the commander to utilize his assets in roles where they are effective and to remove them from roles where they are particularly vulnerable. One might ask what would the effects be if submarine launched AAW weapons were developed? In such a case all ASW air platforms would be affected, not only ASW airships. It should be borne in mind, however, that once detected the submarine itself is a very vulnerable platform. It operates effectively by avoiding detection. For a submarine to launch an attack on an air platform is to precisely mark its own position. This is not a tactically effective option for the submarine to exercise.

An impression that many have is that airships, particularly non-rigids, have little or no survivability if hit. This impression is probably generated by memories of the HINDENBURG disaster and by childhood experiences of poking a single hole in a balloon. The experiences of the Goodyear fleet of airships is enlightening.

> Most ships in the Goodyear fleet have been fired on by thoughtless hunters. Once a bullet went through a ship a few inches back of the pilot. One marksman was arrested and sent to jail in Florida. Pilot Trotter had a curious experience in Oklahoma in 1935, while on his way to the Dallas fair. ... On the fourth morning, finding the ship rather sluggish, Trotter looked around. A glass window from the cabin gives a view of the interior of the bag and as Trotter looked he saw light blinking from 14 bullet holes - through which gas had been pouring for three days!
>
> The nearest hangar where repairs could be made and helium secured was at Scott Field, near St. Louis, 400 miles away. By this time the ship had barely enough lift for the pilot and 100 gallons of gas, not enough for the co-pilot so Trotter flew alone to St. Louis, landing so heavy that the ship had almost to be carried into the hangar, made his repairs and was back in Oklahoma the next day. [Allen, 1943, p. 53]

What is pertinent is that airships no longer use combustible hydrogen, but rather inert helium as a lifting medium; and the gas is at near ambient pressure in the airship envelope. It is not at a condition of overpressurization, and if the envelope is punctured the gas does not catastrophically rupture the bag.

F. ACQUISITION COSTS

If the Navy were to decide that an airship capable of ASW and AMCM missions was desirable, what would be the acquisition cost? Although beyond the general scope of this thesis, a brief investigation has been made. At the request of the Office of Naval Research, Summit Research Corporation of Gaithersburg, Maryland is preparing a study of estimated

life cycle costs and logistics for maritime patrol airships. In a preliminary draft Summit [Note 2, p. 12] estimated the unit cost at $5.0 million for a buy of 50 airships.

The assumption of a buy of 50 airships is not unreasonable. The Coast Guard has a well defined need for a surveillance system to enforce the 200 mile fisheries limit and to attack the evergrowing drug smuggling problem. This in itself would require a significant number of ships.

The Coast Guard and NASA are preparing to sign a Memorandum of Agreement to develop a prototype non-rigid airship suitable for testing the maritime patrol airship concept as well as a heavy lift design.

From the foregoing it can be seen that there exists sufficient broad interest to make it feasible for the Navy to participate in a revitalization of a military lighter-than-air program without bearing all of the financial burden.

Minimization of risks should be a basic constraint in a return to airship technology. Toward this end automated control systems proposed in this thesis were selected heavily from already existing technology. New design equipments or major modifications were consciously avoided. Of the equipment proposed in Chapter 4, 83% is off-the-shelf, 12% is off-the-shelf with slight modification, 4% is off-the-shelf with major modification, and only 1% is new design.

II. PURPOSE, METHODOLOGY, AND LIMITATIONS OF THESIS

A. PURPOSE

The purpose of the thesis is to propose an automated control design and then to determine minimum feasible crew size for the on station operations of the airship using analysis techniques and assuming the use of off-the-shelf systems.

Minimizing crew size is important for two reasons. The first is that the All-Volunteer Forces face an ever dwindling supply of eligible recruits over the next ten years. The second is that the single largest cost of operating an airship is the cost of personnel [Rappaport, Note 2, p. 20]. Personnel costs exceed acquisition costs, maintenance costs, and costs of consumables over the life cycle of the airship.

Three estimates have been made of the crew size for an ASW airship. Two of these estimates [Goodyear Report; Rappaport, Note 2] were made specifically for the airship concept design analyzed in this thesis. The third estimate [Flanigan, 1978] was made for a rigid ASW airship, a much larger design.

Goodyear Aerospace Corporation included statements of crew size in each of the eight mission profiles contained in their conceptual design study [Goodyear Report, 1979, pp. 9-16]. These statements are summarized here:

Mission	Duration	Crew
ELT (Enforcement of Laws and Treaties): Search and Board	27.5 hrs.	11
MEP (Marine Environmental Protection): Initial Clean-up	12.5 hrs.	6
MO/MP (Military Operations/ Military Preparedness): Towed Array ASW, Attack	27.5 hrs.	11
PSS (Port Safety and Security): Hazardous Vessel Escort	8.35 hrs.	6
SAR: Search, Board, Tow	15.6 hrs.	8
A/N (Aids to Navigation): Buoy Maintenance	17.0 hrs.	8
MSA (Marine Science Activities): Ice Patrol (St. Johns)	35.5 hrs.	11
IO (Ice Operations): Ice Mapping (Great Lakes)	20.5 hrs.	6

The Goodyear study does not specify what the crew stations would be. However from Figure 2, which is reproduced from the Goodyear study, the crew stations appear to be: pilot, co-pilot, flight engineer, radar, nav/comm operator, acoustic operator, and two visual observers. This would be eight crew stations. Unfortunately the study does not provide any rationale for arriving at either the crew stations or the number of personnel required.

Summit Research Corporation also provided personnel estimates for the maritime patrol airship conceptual design [Rappaport, Note 2, p. 7]. These tables are reproduced here:

Table 5

Summit Research Corp. Estimate of Crew Size

Mission Duration	Crew Size
0 - 10 Hours	5
10 - 20 Hours	8
More than 20 Hours	13

Table 6

Summit Research Corp. Estimate of Crew Stations and Skill Levels

		Crew Size		
Position	Rank	5	8	13
Pilot	CDR			1
Pilot	LCDR	1	1	1
Co-Pilot	LT	1	1	1
Co-Pilot	LTJG		1	1
COM/NAV	CPO	1	1	2
Radar/Sensor Operator	PO1	1	3	4
Visual Observer/ Rigger	PO3	1	1	3

This study, like the Goodyear Report (1979), does not provide any rationale for the results obtained. It is apparent, however, that only a two section watch is envisioned even for missions lasting more than 20 hours.

Flanigan [1978, p. 44] provided an estimate of crew size for a much larger ASW rigid airship. His mission concept was

for operations independent of other naval units. As a result the airship was sized much larger than the maritime patrol airship being considered herein. Nevertheless the crew functions envisioned by Flanigan are nearly identical to the ASW functions performed by the maritime patrol airship in the ASW scenario presented in Chapter 3. Flanigan's watch station assignments were:

pilot
co-pilot
flight engineer
navigator/radioman
TACCO
sensor I   AQA - 7/TASS
sensor II AQA - 7/TASS
sensor III radar/MAD
sensor IV ESM
inflight technician.

He postulated that there would be three watch sections manning all of the above stations, that all sensor operators would be cross trained, and that the ESM would be monitored continuously. Flanigan did not justify the requirements for 10 men per watch section.

With a single exception there does not appear to have been significant analysis of airship manning requirements using human factors engineering techniques. Nearly thirty years ago Channel (1950) reviewed Navy ASW airship manning. However the improvements in technology which have occurred since

then make it necessary to review the manning situation again.

B. METHODOLOGY

The determination of minimum feasible crew size was accomplished in two steps. First a manpower economical design for the airship's control systems was developed. Second manpower requirements to operate the proposed design were determined by analytical techniques.

1. Manpower Economical Design

The intent in developing a manpower economical design was not to produce a finely accurate engineering design. Such activity is beyond the ability of the author. The intent was rather to produce an equipment list, using off-the-shelf technology, which would serve to reduce the airship crew requirements as conceptualized by Goodyear [Goodyear Report, 1979], Summit Research Corporation [Rappaport, Note 2; Flanigan, 1978].

The intent was also to comply with the guidance given in Office of Management and Budget Circular Number A-109 [OMB A-109, 1976, paragraph 11]. This guidance directs the exploration of alternate system designs within the mission need and program objectives to emphasize innovation and conceptual competition. The personnel manning conclusions drawn by Goodyear, Summit Research Corporation, and Flanigan all appear to be based on traditional airship and aircraft control system designs.

In order to try a different approach, non-aviation automated control systems were considered. Although an air platform, the airship is similar in many respects to a ship. It is buoyant and operates at relatively slow speeds most of the time (compared to other air platforms). One control system from undersea technology appeared to offer many advantages.

The principal source chosen for automated control systems was the DSRV (Deep Submergence Rescue Vehicle) system. Although not an aviation platform, the DSRV operates in the ocean environment quite similarly to the way in which an airship operates in the air environment. Both platforms are designed to operate neutrally buoyant, i.e., when in a static condition they float in the operating environment. Both platforms are also capable of hovering.

The DSRV system was developed to rescue personnel from a bottomed nuclear submarine. As a result the DSRV had extreme design constraints. The vessel had to be strong enough to withstand thousands of pounds per square inch of sea pressure, large enough to carry 27 men on each rescue trip, and yet small enough to be loaded into a C-141A jet transport. This resulted in size limits of a length of 52 feet and a beam of 8 feet. Minimization of operating crew was therefore a driving factor.

In order to meet this goal a control system design was adapted from the Apollo space capsule. With a computerized sensor and control system three men were capable of

performing all crew functions which included piloting, navigation, communications, search, mating and demating the DSRV to a distressed submarine, and monitoring all of the propulsion, electrical, hydraulic, and life support systems on board. These capabilities were all achieved, and the technology is now over 10 years old. Moreover the control equipments designed for the DSRV are all located inside the pressure hull and operate in a dry, sea level, air environment. They could be installed in an airship control car, and their performance would not be affected.

Additional sources for equipment to be installed in the maritime patrol airship came largely from other air platforms. Equipment was selected from P-3C and S-2 aircraft, from the IAIRTASS (interim airborne towed array sonar system), from the AMCM (airborne mine countermeasures) equipment developed for use with the Navy's RH-53D helicopter, and from the LAMPS (light airborne multi-purpose system) helicopter. Certain equipments, which have been tentatively identified by Naval Air Development Center Warminster and the Coast Guard as candidates for inclusion in the maritime patrol airship, were taken as requirements. These equipments are found on the Coast Guard Falcon 50 aircraft.

2. Manpower Requirements Determination

The determination of minimum crew requirements was achieved following the guidelines of the Military Specification for Human Engineering Requirements [MIL-H-46855B, 31 January 1979].

The starting point for such an analysis is a baseline scenario. The only information available was the eight "mission profiles" contained in the Goodyear study [Goodyear Report, 1979, pp. 7 to 16] and presented by the Coast Guard in Senate testimony [U.S. Congress, LTA, 1979, pp. 10 to 13]. Using these profiles a baseline scenario was developed which included airship launch, cruise out, operations on station (the Coast Guard SAR mission), cruise back, and landing. The launch, cruise out, cruise back, and landing elements of the baseline scenario are essentially the same for all missions. Only the on station operations change for each mission. As a result, these basic elements were not repeated in the other scenarios. After developing the basic scenario a scenario was developed for ASW and another for AMCM on-station operations. These scenarios are presented in Chapter 3 of this thesis.

After the scenarios were developed each common element (launch, cruise out, cruise back, and land) of the baseline scenario and each on station operations scenario (Coast Guard SAR, ASW, and AMCM) was analyzed to develop crew task inventories.

It should be noted that at this point the more correct procedure would have been to analyze each scenario and to determine the best allocation to personnel, equipment, software, or combinations thereof. This was consciously not done to enable the analysis to proceed rapidly enough to reach some final manpower conclusion. Although the final conclusions

must lose some validity by circumventing the rigors of methodology, it was the intent of the thesis to indicate in a general way the manpower economies that are possible. A rigorously complete human factors analysis was not possible within the time constraints of this work in view of the necessity to begin at the level of the baseline scenario and lack of previous data. Similarly, a necessary input at each phase of analysis is a management decision to select one of the options available. As a result, equipment was selected assuming a management decision to opt for automated, yet proven (therefore old), control equipment and avionics packages currently in the DOD inventory.

It is also appropriate here to emphasize to the reader that the specific operating parameters, e.g., altitudes, velocities, and times, are for a single (not finalized) design and may vary depending on the actual design of the airship and its tactical employment. Readers should therefore not place undue reliance on specific altitudes, speeds, or tactics.

The task inventories were then analyzed and individual tasks were assigned to specific crew members. At this phase of the analysis performance times were also assigned to each task. These times were obtained by questioning various pilots and operators of the proposed equipment. Since nearly all of the equipment already exists, such a procedure is deemed acceptable. As in any system development, precision time measurements would have to be performed at a later stage when

the equipment package was better defined and a human operator simulation could be performed.

The final phase of manpower requirements determination was the production of a time line analysis of the baseline scenario and the Coast Guard SAR on station operations. The Coast Guard SAR scenario was chosen since SAR combines long duration with varied tasks. Due to time constraints, time line analyses were not produced for the ASW and AMCM scenarios. However, since a complete flight profile was analyzed, adequate initial results were obtained.

It is appropriate here to observe that there exists in the literature rather elastic applications of the terms: mission profile, mission scenario, task analysis, and time line analysis. Three principal sources were consulted for methodological and format guidance. They were Malone, Gloss, and Eberhard (1967), Gear (1976), and Van Cott and Kinkade (1972, chapter 1). All three sources had varying information requirements for the various analysis techniques. They were not radically different. However, it is apparent that care needs to be exercised by managers and analysts working in this field to insure that agreement exists on terms and format. Failure to do so will probably result in dissatisfaction over the results of specific analyses. The format used in this work for the task analyses follows Browning, Lauber, and Scott (1973). The format used for the time line analysis was adapted from Malone, Gloss and Eberhard (1967).

C. LIMITATIONS

The author is not an aviator and has never flown in an airship. In order to alleviate this shortcoming the assistance of the thesis co-advisor, LCDR William F. Moroney (MSC), USN, an aerospace experimental psychologist and the thesis second reader, Associate Professor Donald M. Layton, a qualified Navy lighter-than-air pilot was sought out.

One of the conclusions of this thesis is that it is possible to operate the airship with only one pilot. The adequacy of one pilot from a policy standpoint is beyond the scope of this work. Although for long duration missions there would be more than one pilot on board, since there would be multiple watch sections, this would not be true for shorter missions with only one watch section on board. It is felt that the nature of the airship (relatively high speed dynamic flight not required to remain airborne) and the one-man control afforded by modern fly-by-wire control systems makes this a reasonable design decision. However such a decision obviously falls within the prerogative of the controlling agency not the analyst.

Certain other task assignments made in this thesis depend upon the pilot decision. Certain crew functions have been traditionally performed by the pilot or by the co-pilot simply because there were two pilots available. One example of this is the requirement that only the pilot or co-pilot can communicate with an air controller. In the task analyses in this work such practices are not always observed because functionally

it is possible for another crew member to perform this task.

No spatial equipment layouts were performed. The next step to be accomplished in a complete human factors analysis of the feasibility of the design proposed would be to construct a layout of the equipment at each crew station.

No analysis of personnel skill levels or training requirements was performed. In order to logically arrive at a final design decision such an analysis would have to be completed. The procuring authority would then have to decide if he were capable and willing to implement such a design. Manpower recruiting plans would have to be developed.

Only the aircrew operating tasks were analyzed. No analysis of maintenance personnel or ground support personnel requirements was made. Based upon the historical experience of Navy ground handling crews alluded to in chapter one, ground handling would probably not be a problem area. However maintenance personnel requirements is an area that would demand analysis and close scrutiny of equipment reliability data. It is certainly a truism that automated systems may reduce operational crew requirements but result in complex hardware systems. Maintenance of such systems deserves at least as much analytical emphasis as operation of the systems.

III. MISSION SCENARIOS

A. SCENARIO FOR COMMON ELEMENTS (LAUNCH, CRUISE OUT, CRUISE BACK, LAND) AND FOR COAST GUARD SAR ON STATION OPERATIONS

Figure 3 is a profile for the SAR mission depicting the route to the search area and return to base in a two dimensional format. The vertical axis represents altitude from sea level to 5,000 feet. The horizontal axis represents sequential events. Each mission begins with the crew's arrival at the airship to begin launch and terminates with the airship back at home base with postflight checks completed. Certain preflight activities, e.g., the detailed preflight inspection and the weight and balance computations, are completed well in advance by the aircrew and the airship is put in a "ready duty SAR" status. These required preflight activities are contained in the task analysis in order to completely cover crew activity. The actual SAR mission, however, begins with the aircrew manning the airship in its "ready duty SAR" configuration.

The SAR mission may involve one or more of five elements: rescued persons may be taken directly aboard the airship, the airship crew may fight fire or flooding aboard an endangered ship, a disabled vessel may be towed by the airship, and the airship may serve as an on-scene command center and search platform in multiunit operations. The most complex flow of events would involve a vessel in distress which

I LAUNCH

1 Warm up / Take off
2 Climb

II CRUISE OUT

3 Cruise

III ON STATION OPERATIONS

4 Search
5 Descend
6 Hover
7 Loiter
8 Hover
9 Tow
10 Hover
11 Climb

IV CRUISE BACK

12 Cruise

V LAND

13 Descend
14 Land

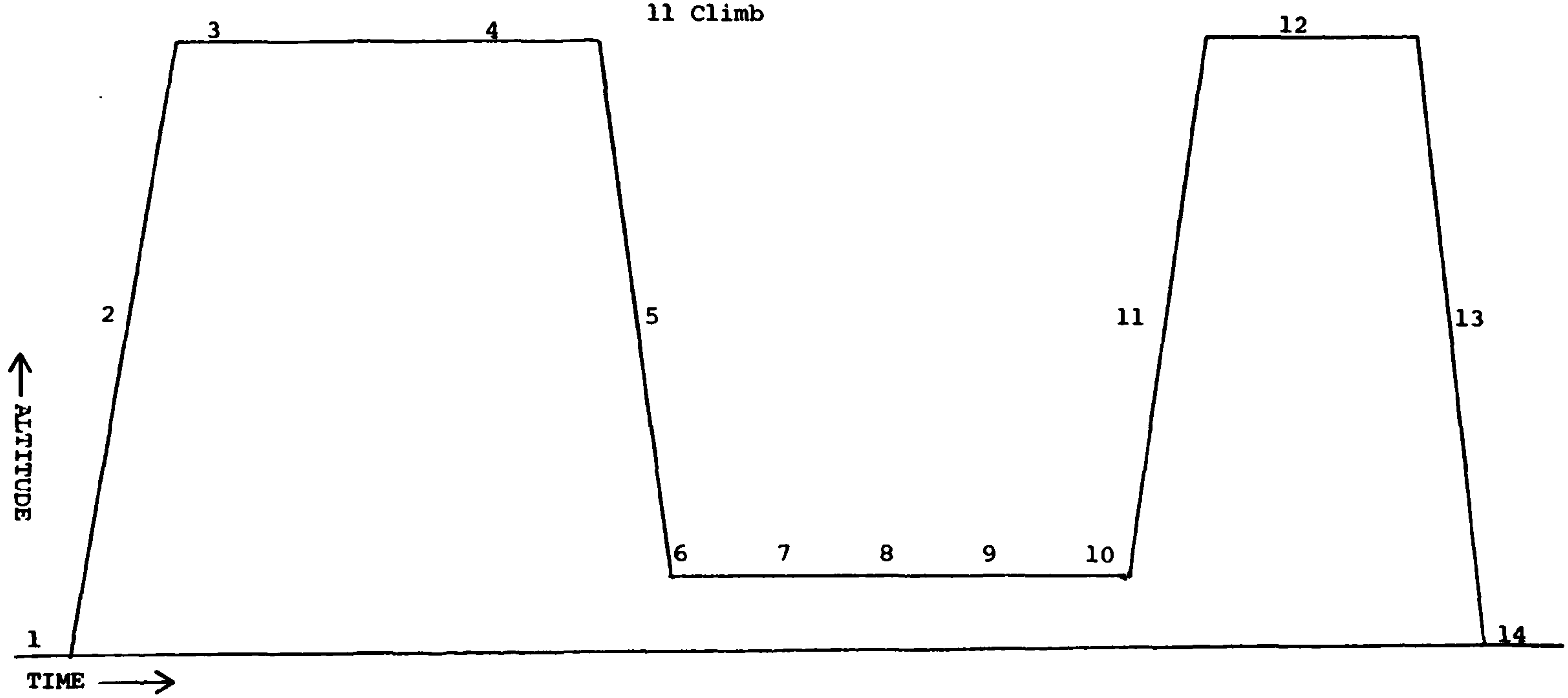


Figure 3 Baseline and SAR Mission Profile

requires the airship to render assistance (equipment and/or personnel) followed by towing the distressed vessel. Accordingly this scenario develops the tasks required for rendering assistance to and towing a distressed vessel. Additionally the scenario develops the tasks required for recovery of survivor(s) in the water since this is also a manpower intensive evolution.

The airship will be based at a Coast Guard Air Station at the start of a mission. The airship crew will be briefed prior to launch on the specifics of the SAR emergency, e.g., vessel in distress, person lost overboard, vessel overdue, etc. Based upon the information available, e.g., flooding on board large merchant vessel, additional equipment and personnel may be embarked prior to launch. Weather information will be available and will be briefed. Anticipated mission duration (29 hrs.) will require sufficient personnel for a two-section watch to be embarked in the airship.

After launch the airship will climb to cruise altitude (5,000 feet) and cruise for 25 nm at 90 kts. (dash speed). Upon reaching the designated area, search will be conducted for 1.5 hrs. at 60 kts.

1. Vessel in Distress

The airship sights the distressed vessel and descends from cruise altitude (5,000 feet) to 100 feet. Attempts are made to communicate with the distressed vessel by radio. If communication by radio is not successful, the airship hovers

in the vicinity of the vessel and attempts to communicate by externally located loudspeakers connected to the PA system or by lowering a hand held transceiver to the vessel. After ascertaining the nature of the casualty (fire/flooding are assumed as "worst case" situations), the airship remains in hover and transfers personnel and equipment to the distressed vessel. After transfer is completed the airship loiters in the vicinity of the vessel while the casualty is combatted. After a nominal time (2 hours) the airship returns to hover over the vessel and passes the tow line. After the tow line is passed and made fast to the distressed vessel the airship begins towing operations. Towing operations continue until the tow can be transferred to a surface vessel. The capability exists for up to 21 hours of towing [Goodyear Report, 1979, p. 55]. The airship hovers to transfer the tow and recovers assistance personnel and emergency equipment if conditions permit. Upon transfer of the tow the airship climbs to cruise altitude (5,000 feet) in preparation for return to base.

2. Recovery of Survivors

The airship sights the survivor(s) in the water and descends from cruise altitude (5,000 feet) to 100 feet. The airship approaches the survivor(s) from downwind and hovers over the position at 100 feet. Using the airship external loudspeakers, each survivor is asked to signal by raising his arm if he is not injured. Injured survivors will be picked up first. After all injured survivor(s) have been

brought on board, uninjured survivor(s) will be picked up. The rescue crewman lowers the rescue basket by winch. Survivor(s) enter the rescue basket by themselves. When the rescue crewman verifies that a survivor is completely inside the rescue basket he hoists the survivor up and into the interior of the airship. This is repeated as many times as necessary until all survivors are recovered.

If the rescue crewman observes that a survivor is unconscious or injured to the extent that he cannot enter the rescue basket by himself and no other survivor can assist, he reports this to the pilot/airship commander via the ICS. The crewman communicates his appraisal of the situation to the pilot/airship commander who considers all factors, e.g., sea state, visibility, etc. The airship commander decides whether to send the crewman into the water to render assistance to the survivor.

If the decision is made to send the crewman into the water to render assistance, the crewman enters the water by being lowered in the rescue basket from the airship which hovers at an altitude from 10 to 40 feet depending on the sea state. When the rescue crewman has placed the injured survivor in the rescue basket and is in the basket himself he signals the airship (light signal at night, visual or smoke by day). The basket is winched up and the rescue crewman rides up with the survivor to provide support to prevent any further injuries, e.g., to the head and back area. When the rescue crewman and the survivor have been hoisted into the

interior of the airship, the pilot is informed. The airship then comes out of hover and climbs back to cruise altitude (5,000 feet) in preparation for return to base.

3. Return to Base

After reaching cruise altitude the airship proceeds for 100 miles at 50 kts. Upon reaching its home base the airship will descend and land. The crew will conduct normal post flight checks.

B. SCENARIO FOR ASW (CONVOY/NON-CV TASK GROUP) ON STATION OPERATIONS

The ASW scenario consists of the activities of one of three airships providing ASW protection to a group of surface ships engaged in an ocean transit without an aircraft carrier but with two or three LAMPS equipped DD/FF escorts present. The entire ASW mission would consist of three or more airships taking off from an air station, cruising out to rendezvous with the surface group near the departure harbor, providing ASW protection to the surface group during the ocean transit, being detached from the surface group by the ASW Screen Commander when at or near the destination harbor, and finally cruising to and landing at an air base. Since launch, cruise out, cruise back, and landing are the same activities for all missions they are not repeated here. Each airship will have three complete watch sections on board plus one man to cook. Total crew size is 10.

Figure 4 is a profile for the ASW mission of one of the three or more airships which would provide ASW protection.

I LAUNCH

1 Warm up / take off
2 Climb

II CRUISE OUT

3 Cruise

III ON STATION OPERATIONS

4 Descend
5 Rendezvous
6 Take station (30 mins.)
7 Deploy array (17 mins.)
8 Search/classify contacts (2.3 hrs.)
9 Recover array
10 Localize with MAD
11 Attack
12 Proceed to AIFR ship
13 AIFR and replenish
14 Return to station
15 Repeat steps 6 through 9 on a 'round the clock basis. Repeat steps 10 and 11 as directed. Repeat steps 12 through 14 as required.
16 Detach
17 Climb

IV CRUISE BACK

18 Cruise

V Land

19 Descend
20 Land

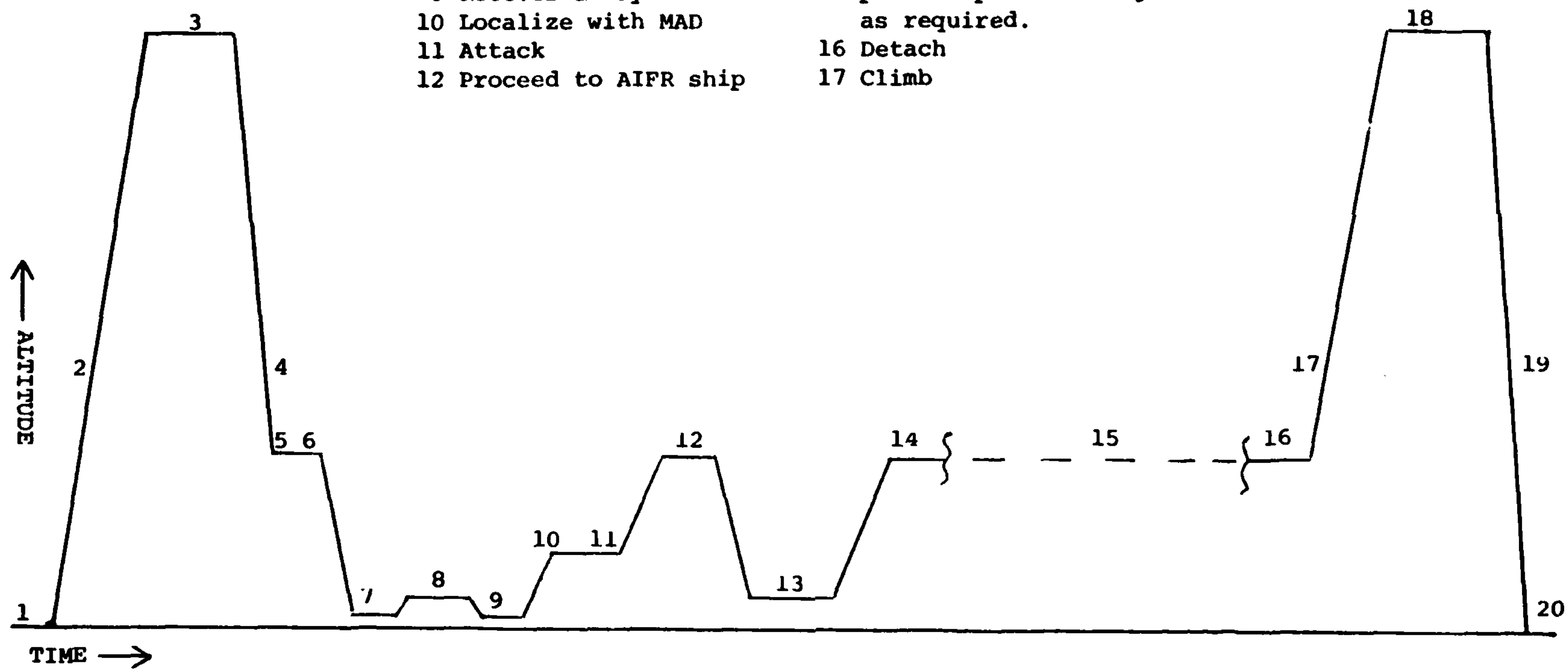
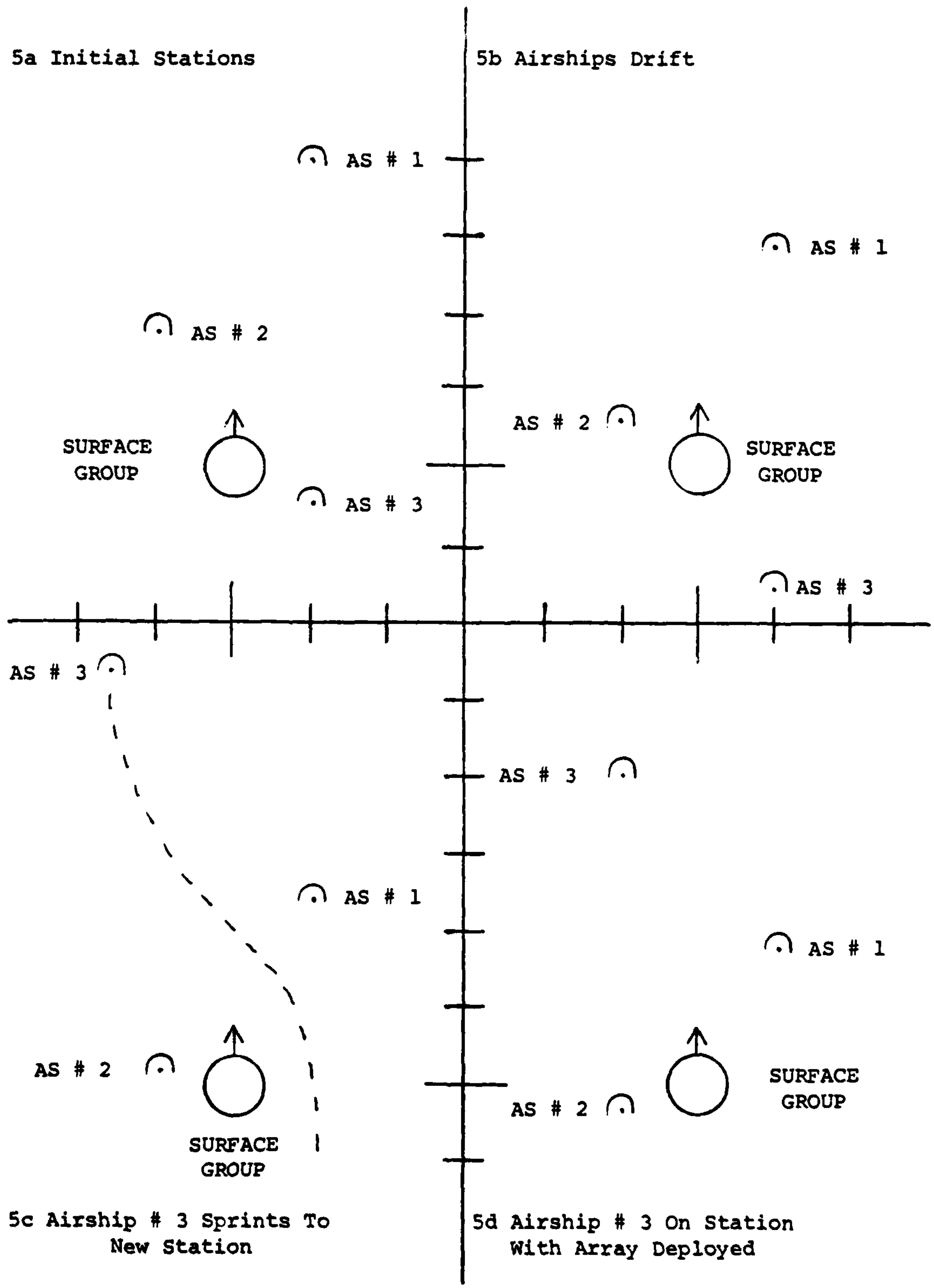


Figure 4 ASW Mission Profile

The vertical axis represents altitude from sea level to 5,000 feet. The horizontal axis represents sequential events. The profile includes the activities which would take place during an ocean transit opposed by enemy submarines but does not include enemy surface or air opposition.

Upon rendezvous with the surface group the airships descend to 1,000 feet and report to the ASW Screen Commander (embarked on one of the surface escorts) for initial station assignments. As indicated in Figure 5, initial stations place two airships ahead of the surface group and the third airship astern. (These stations are provided for illustrative purposes only.) Each airship takes station at 90 kts. Upon rendezvous the airships will be placed in an electronic emission control (EMCON) condition by the Screen Commander. Modern ASW strategy dictates the avoidance of active electronic or sonar emissions to the maximum extent feasible to avoid providing enemy submarines with direction finding information.

Upon reaching the assigned station the airship descends to 40 foot altitude, hovers, and drops an expendable bathythermograph (BT) device to obtain a sound velocity profile to determine optimum array deployment depth. Concurrent with the BT drop the airship commences deploying the linear array and tow cable. The results of the BT drop are analyzed, and the proper amount of array cable is deployed to suit the tactical situation. (In general, longer lengths of tow cable cause



1 inch = 10 nautical miles

Figure 5 Airship Screening Stations

the array to be deployed at greater depths.) After 17 minutes (time required for maximum tow deployment) the airship ascends to a height of 100 feet and commences towing at a speed of 3 to 6 kts. The airship maintains sufficient forward motion to keep the array at the depth desired, but essentially drifts on station while the surface group proceeds.

When each airship drifts astern of the surface group to a nominal distance of 8 nautical miles it descends back to 40 feet, hovers, and recovers the array. As soon as the array is back on board, the airship climbs to 1,000 feet and sprints at 90 kts to a nominal position 23 nautical miles ahead and on the opposite side of the surface group. When at this position the airship slows, descends back to 40 feet and hovers. It again goes through the sequence of making a BT drop, deploying the array, and drifting.

Direct tactical voice communications (UHF frequency) between the Screen Commander and the airship in the most distant forward station might be difficult during periods of maximum separation (23 NM). This would be overcome by the intervening airship acting as communications relay. (In "INITIAL STATIONS" of Figure 5 AS#2 would be comm relay between AS#1 and the Surface Group.)

Initial acoustical contact on a target of interest is displayed on the bearing-time recorder (BTR) of the IAIRTASS. BTR displays are available at the pilot, the comm/nav, and

at the ASW sensor operator stations. The airship is maneuvered 90 degrees either to port or to starboard to resolve bearing compliment ambiguity.[1] When the actual target bearing is determined, the Wideband Acoustic Processor II (WAP-2) is used to analyze and classify the detected target of interest acoustical data. When the actual target bearing is known, the airship can be maneuvered as necessary to maintain contact. Only a single maneuver is required to determine actual target bearing.

A tactical voice radio report is made to the Screen Commander and contact with the target is maintained if classified as a submarine. Reporting is continued as dictated by tactical doctrine.

If the target is not held by one of the other two airships, the Screen Commander would undoubtedly reposition one or both of them to attempt to obtain a second line of bearing. Since passive sonar detection does not, of itself, provide target range, a second line of bearing from another platform is required to establish the target's position. Other methods are possible but will not be described in this work to avoid classification of the thesis.

For analysis purposes, this scenario will utilize the airship to localize and attack the target. The desirable

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[1]An explanation of bearing compliment ambiguity is beyond the scope and unclassified nature of this work.

tactic for the Screen Commander to employ would be to use a LAMPS helo, if available, to localize and attack. This retains the passive detection capability of the airships for maximum protection. However it will be assumed here that no LAMPS helo is available. In this case, while two airships maintain passive contact on the target, the third airship will recover its array and prosecute the target.

After recovering its array, the attacking airship receives tactical direction from the anti-submarine warfare air controller (ASAC) designated by the Screen Commander and proceeds at 90 kts speed, 400 foot altitude to the position of the target. The airship uses MAD gear (magnetic anomaly detector) to localize the target and conducts the attack with MK 46 torpedoes.

After completing the attack the airship reduces speed and climbs to 1,000 feet. It proceeds to the surface escort vessel designated to provide in flight refueling and reprovisioning to the airship. Upon reaching the replenishment vessel the airship descends to 100 feet, hovers, lowers a cable and hauls up the in-flight refueling hose. The airship refuels, lowers the fueling hose back to the replenishment vessel, and commences to restock expendable BT devices and food/water as required from the surface vessel.

After completing refueling/replenishing the airship returns to its assigned station. The airship design proposed by Goodyear Aerospace Corpration indicates refueling

during ASW operations will be required every 27.5 hours [Goodyear Report, 1979, p. 11]. This is minimum endurance time. Goodyear indicates the maximum endurance to be 101 hours as contained in Table 2.

Sprint and drift passive sonar operations and in-flight refueling/replenishment continue until the surface group completes its transit. When detached by the Screen Commander the airships climb to cruise altitude (5,000 feet) and proceed to their designated landing field.

C. SCENARIO FOR AMCM (AIRBORNE MINE COUNTER-MEASURES) ON STATION OPERATIONS

Figure 6 is a profile for the AMCM mission depicting the route to the operational area, on station operations, and return to base in a two dimensional format. The vertical axis represents altitude from sea level to 5,000 feet. The horizontal axis represents sequential events.

Airborne mine countermeasures involve 4 different types of operations which are:

(1) Mark 103 - MCM operations for defeating moored mines

(2) Mark 104 - MCM operations for defeating magnetic mines

(3) Mark 105 - MCM operations for defeating acoustic mines

(4) Mark 106 - MCM operations which combine MK 104 and 105 equipment to defeat both magnetic and acoustic mines simultaneously.

The MK 103 operation represents the worst operational situation in terms of crewman duties, physical tasks, execution time and hazards. In addition, the MK 103 operation contains all of the tasks and duties of the other operations

I LAUNCH

1 Warm up / take off
2 Climb

II CRUISE OUT

3 Cruise

III ON STATION OPERATIONS

4 Descend
5 Survey area
6 Drop and monitor transponders
7 Calibrate transponder net
8 Deploy AMCM gear
9 Commence sweeping
10 Complete sweeping
11 Recover AMCM gear
12 Climb

IV CRUISE BACK

13 Cruise

V LAND

14 Descend
15 Land

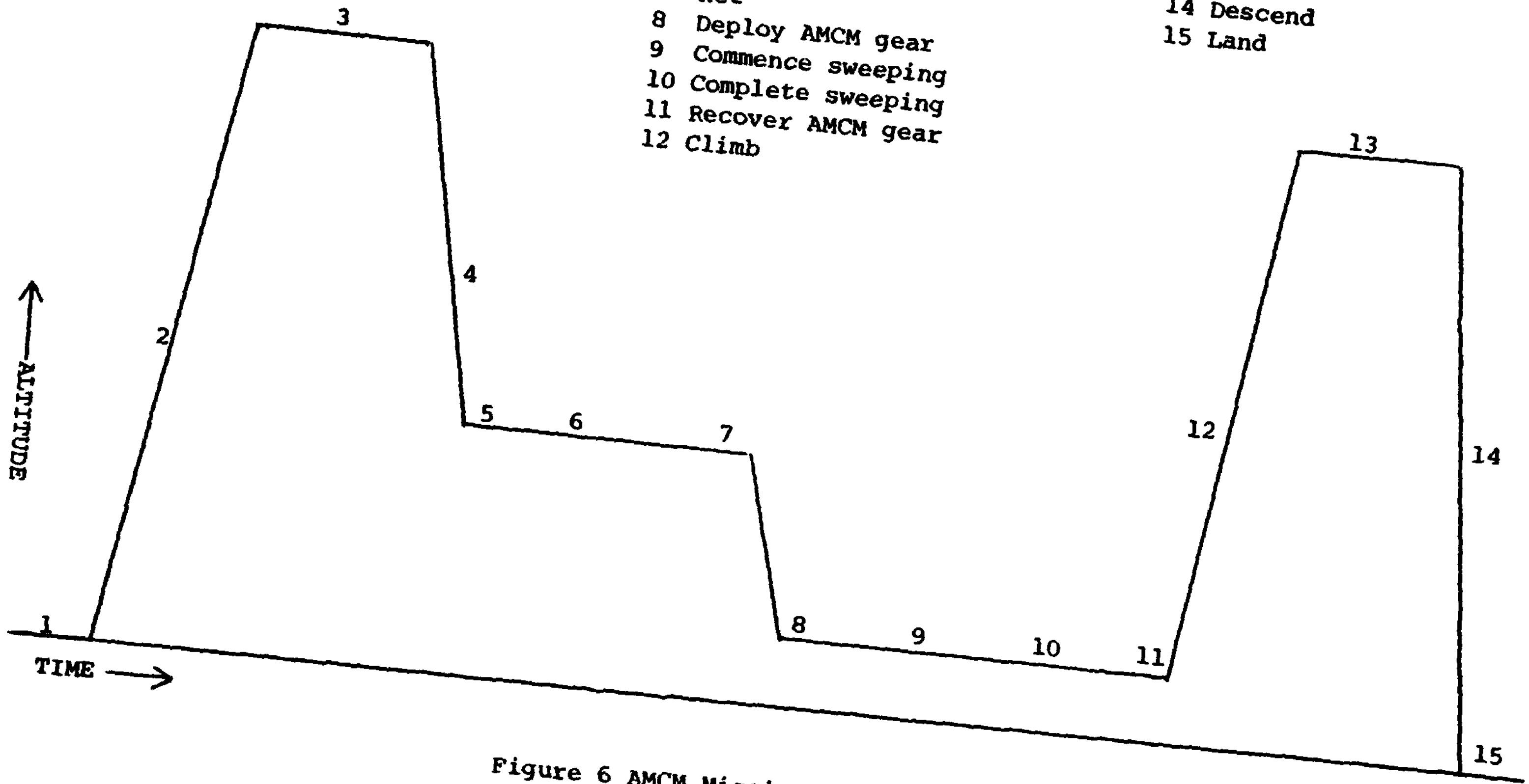

Figure 6 AMCM Mission Profile

and more. Due to this fact, the MK 103 operation will be the only MCM operation treated in this scenario.

AMCM equipment consists of palletized kits that could be readily installed in the airship and removed for specific MCM missions. Such kits are already in existence for use in RH-53D Navy helicopters and could be easily modified for use in the airship. The MK 103 kit is a moored minesweeping system that contains mechanical sweep gear and cutters for sweeping moored mines. A streaming winch kit is also used for this mission. The kit is palletized to allow ready transportation to any desired area. The pallet is secured to the airship aft control car floor. It supplies hydraulic power to the winches through hoses connected to the airship's hydraulic system. There are two streaming winches in the kit. They are mounted side by side and have removable drums. The drums are prewound with cable.

Each AMCM mission begins with the airship at a forward operating base near the area to be swept. This forward base can be either a land site (but need not be an air field) or an LSD/LPD type support ship. All that is required is to have an airship portable mooring mast available.

The AMCM mission begins and terminates with the same launch, cruise out, cruise back, and land segments that are contained in the SAR (Coast Guard) Mission Scenario. They will not be repeated here.

On station operations begin with the airship reaching the minefield area at cruise altitude (normally 5,000 feet although

this could be lower if the operating base is in close proximity to the minefield). Upon reaching the minefield area the airship will descend, if necessary, to a nominal altitude of 1,000 feet. The airship will conduct a survey of the area at this altitude to identify possible locations to drop radio transponders for use by its nvaigation system.

Precision navigation and track recording is critical while sweeping a minefield. The airship navigation system accomplishes this with a Transponder Interrogation Transceiver (TIT) and radio transponders. The TIT is capable of interrogating and monitoring returns from up to ten transponders set at different frequencies. These transponders may be placed by friendly ground forces prior to the first AMCM mission or can be launched by the airship itself. Accurate locating of the beacons prior to the arrival of the airship is not necessary. The airship navigation system is capable of precisely fixing the beacon locations itself by a sampling process known as baseline crossing.[1] After this calibration is performed the first time, it need not be repeated. Once the beacon positions are recorded, they can be loaded into

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[1]A detailed explanation of beacon position calibration by baseline crossing is beyond the scope of this paper. Very simply stated, it is a process in which the airship computer (CPC) measures ranges from beacons as the airship is maneuvered between adjacent beacons and by use of trigonometric formulae determines the relative position of each beacon in relation to all others. These relative positions are subsequently convertible to absolute lat/long positions by the nav system.

the CPC at the commencement of each subsequent AMCM mission and sweeping can commence as soon as the sweep gear is deployed.

Upon determining the precise locations of the radio beacons the airship commences streaming the MK 103 gear. Figure 7 illustrates the basic assembly configuration of the sweep gear. The gear is streamed from the aft end of the airship at altitudes of 150 to 50 feet while hovering and/or moving slowly ahead.

The activities of the five crewmen who stream and recover the MK-103 gear are already established procedures used when operating from the RH-53D helicopter. After the gear is streamed the airship navigation system is provided with the desired sweep legs (length, separation between legs, and number of legs to be run) and sweeping commences. The Transponder Interrogation Transceiver interrogates the radio transponders automatically and provides the range returns to the navigation system. The navigation system flies the airship to conform to the sweep legs with which it has been provided.

As mines are cut by the sweep gear the officer in tactical command of the operation is informed by radio communication. Detonation of swept mines will be accomplished by another unit at the direction of the officer in tactical command.

Upon termination of minesweeping activities, the airship pilot takes manual control of the airship and the gear is recovered while the airship moves slowly ahead.

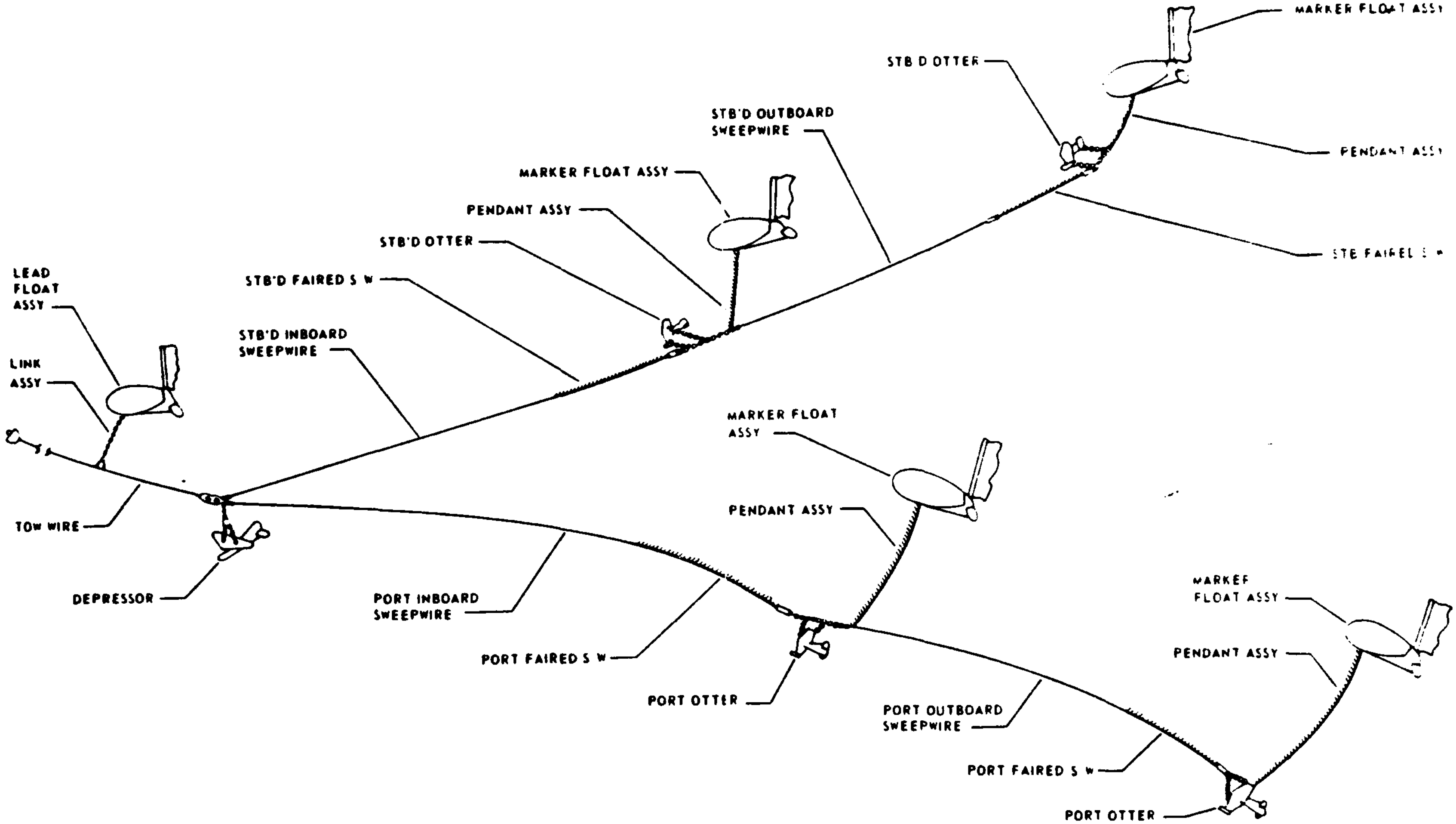


Figure 7 MK-103 AMCM Gear Assembly

After recovery of the MK-103 gear the airship climbs back to cruise altitude (5,000 feet) in preparation for return to base.

IV. MANPOWER ECONOMICAL DESIGN FOR CREW STATIONS AND EQUIPMENT

This chapter is divided into four sections. Each section will list the crew stations to be manned for a specific mission and will list for each station the equipment to be provided to the crewman. The four sections are:

- baseline configuration (on board for all missions)
- SAR
- ASW
- AMCM.

As was stated in Chapter Two, an objective in selecting equipments was to rely as much as possible on off-the-shelf technology. Therefore the equipment lists will also include a column labeled "current use." This column will identify the platform on which the equipment is presently installed. If any modifications to a piece of equipment are anticipated this will be indicated by the words "minor" or "Major" after the platform identification. Minor modifications are defined to be panel front alterations, relabeling of meters, or relabeling of display windows. Major modifications are defined to be significant changes to design parameters, e.g., development of changes to computer programs, or conversion of electronic equipment to receive radio frequency returns vice acoustical frequency returns. Brief descriptions of each piece of equipment are contained in Appendix D.

A. BASELINE CREW STATIONS AND EQUIPMENTS

1. Crew Stations

There are two crew stations for the baseline configuration, pilot (P) and communicator/navigator (CN). They are both located forward in the airship control car and are illustrated in Figure 8.

2. Equipment

Although the baseline configuration requires only two crew members, equipment will be listed for a third crew station aft. This equipment would be permanently installed on the airship although not used in the baseline scenario.

a. Pilot Station	Current Use
Ship Control Group	
(1) Auto Pilot/Digital Differential Analyzer	DSRV
(2) Ship Control Electronics	DSRV
(3) Gyro Shelf Assembly	DSRV
(4) Ship Control Mode Panel	DSRV
(5) Ship Control Panel	DSRV
(6) State Display Panel/HSI (Horizontal Situation Indicator)	DSRV + P-3
(7) Ruddevator Angle Meter Panel	DSRV/MINOR
(8) Hand Controllers	DSRV
(9) Emergency Ship Control Panel	DSRV
(10) Computer Control and Display Panel	DSRV
(11) Towing/Sonar Array Monitor Panel	IAIRTASS/MINOR
(12) Torpedo Firing Panel (Torpedo Presetter Panel)	P-3/MINOR

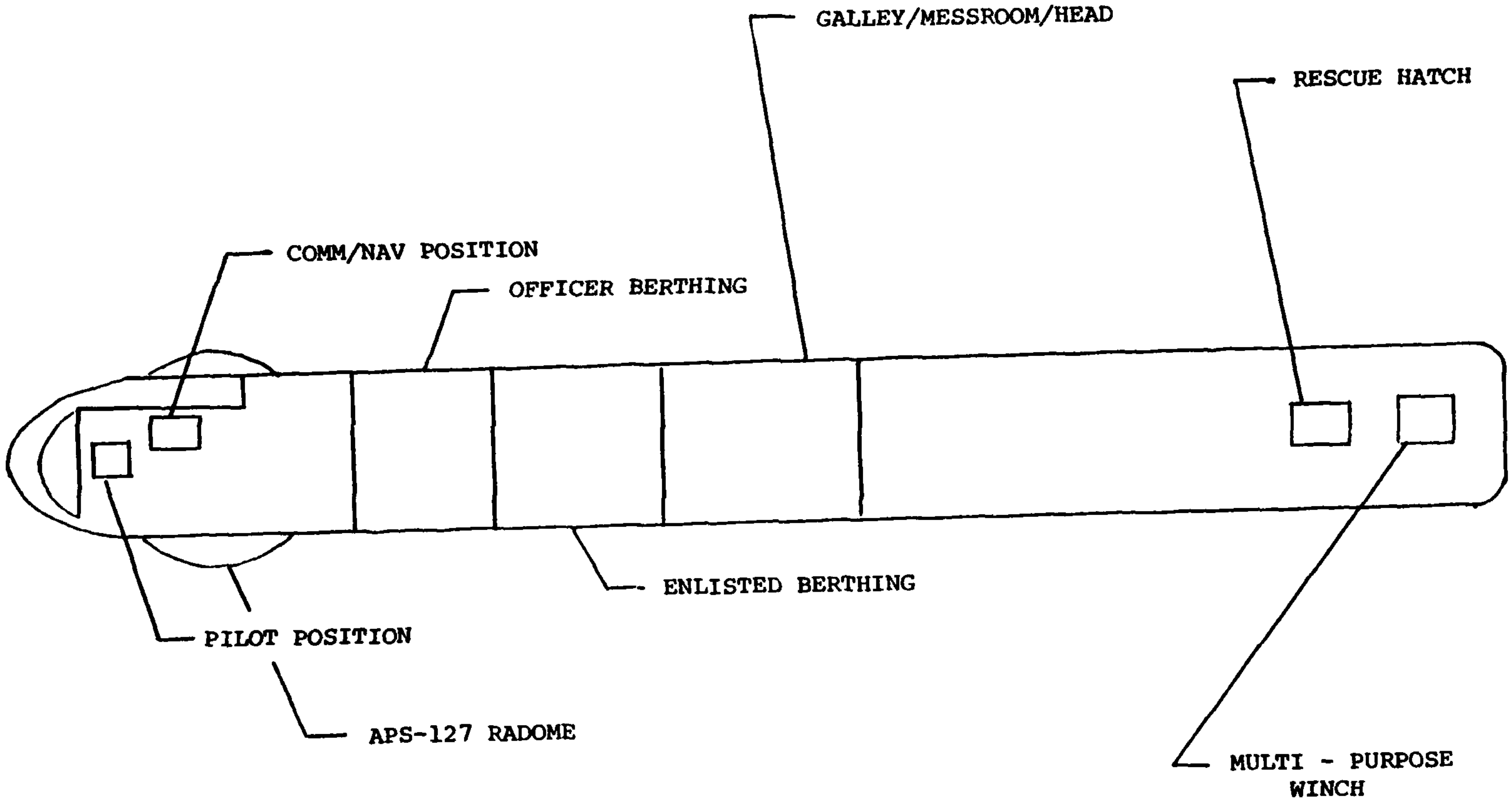


Figure 8 Baseline Configuration

Navigation System Group

(1)	AN/ARN-187 Doppler Velocity Radar Altimeter Set	P-3
(2)	AN/APQ-107 Radar Altitude Warning Set (RAWS)	P-3
(3)	AN/APN-141(V) Electronic Altimeter Set	P-3
(4)	Transponder Release Panel	DSRV/MINOR
(5)	AN/ARN-83 Direction Finder Set	P-3
(6)	AN/ARN-52(V) Tacan Navigation Set	P-3
(7)	ILS Instrument Landing System	P-3

Object Location and Recording Group

(1)	TV Monitor	DSRV
(2)	External Floodlights Control Panel	DSRV
(3)	Film Camera Control Panel	DSRV
(4)	AN/APS-127 Forward Looking Radar (FLAR) Repeater	CG-FALCON 50
(5)	Active-Gated Television/LASER Illumination Control Panel	CG-FALCON 50

Communication Group

(1)	Comm Panel (composed of)	
	(a) ICS	DSRV/MINOR
	(b) ECS (external communications set)	S-3/MAJOR
	(c) UHF channel select	P-3
	(d) HF channel select	P-3
	(e) UWT (Under Water Telephone)	DSRV
	(f) Crypto (Secure Voice)	P-3

(g)	VHF channel select	P-3
(h)	IFF	P-3

Emergency Equipment Group

(1)	Alarm Panel	DSRV/MINOR
(2)	Emergency Jettison Panel	DSRV/MINOR
(3)	Fire Extinguisher Control Panel	P-3
(4)	AN/ALR-54 ESM	LAMPS

Engine Control/Power Distribution Group

(1)	Auxiliary Power Unit (APU) Control Panel	P-3
(2)	Engine Control and Monitoring Panel	P-3/MINOR
(3)	Electric Power System Control Panel	P-3/MINOR
(4)	Lighting Control Panel	P-3/MINOR
(5)	Control and Display Lighting Control Panel	DSRV

Environmental Control System (ECS)

(1)	Air Conditioning Control Panel	P-3

b. Communicator/Navigator Station — Current Use

Navigation System Group

(1)	Inertial, LORAN, and "other"	COAST GUARD
(2)	Central Processing Computer	DSRV
(3)	Standby Heater Control Assembly	DSRV
(4)	Computer Control and Display Panel	DSRV
(5)	Computer Recorder-Reproducer	DSRV
(6)	Computer Program Tape	DSRV/MAJOR
(7)	Mag Tape Storage Bin	DSRV

(8)	AN/APQ-107 Radar Altitude Warning Set (RAWS)	P-3
(9)	AN/APN-141(V) Electronic Altimeter Set	P-3
(10)	AN/APN-187 Doppler Velocity Radar Altimeter Set	P-3
(11)	Transponder Interrogation Transceiver	DSRV/MINOR
(12)	State Display Panel/HSI (Horizontal Situation Indicator)	DSRV or P-3
(13)	Navigation Data Plotter	DSRV
(14)	Barometric Altimeter	P-3
(15)	Clock	DSRV
(16)	NAVSAT	SURFACE SHIP
(17)	OMEGA	P-3
(18)	AN/ARN-83 Direction Finder Set	P-3
(19)	AN/ARN-52(V) Tacan Navigation Set	P-3

Object Location and Recording Group

(1)	TV Monitor	DSRV
(2)	TV Camera Select Unit	DSRV
(3)	Control and Display Power Supply	DSRV/MINOR
(4)	AN/APS-127 Forward Looking Radar (FLAR)	COAST GD
(5)	AN/APS-94 Side Looking Radar (SLAR)	COAST GD
(6)	IR/UV Line Scanner (SCANNER)	COAST GD
(7)	Automatic Data Annotation System (ADAS)	COAST GD/DSRV

Communication Group

(1)	Interior Communications Set	DSRV
(2)	UHF radios (number TBD)	P-3
(3)	HF radios (number TBD)	P-3

(4)	VHF radios (number TBD)	P-3
(5)	Under Water Telephone	DSRV
(6)	Speech and Data Recorder Set	DSRV
(7)	IFF Transponder Control Panel	P-3

<u>Emergency Equipment Group</u>

(1)	Alarm Panel	DSRV/MINOR

<u>Power Distribution Group</u>

(1)	Rack Equipment Power Switching Panel	DSRV/MINOR
(2)	Control and Display Power Switching Panel	DSRV/MINOR
(3)	Sensor Protection Panel	DSRV
(4)	AC Lighting Power Supply	DSRV
(5)	DC Lighting Power Supply	DSRV

<u>Environmental Control System (ECS)</u>

(1)	Air Conditioning Control Panel	P-3
(2)	Equipment Coolant Group	DSRV

	c. Aft Crew Station	Current Use
(1)	Intercommunications Panel	P-3
(2)	ECS (Exterior Communications Set)	S-2/MAJOR
(3)	Air Conditioning Control Panel	P-3
(4)	Zodiac Boat and Boat Winch (Coast Guard configuration only)	COAST GD
(5)	Personnel Recovery Winch	RH-53
(6)	Towing Winch and Winch Control and Monitor Panel	NEW DESIGN
(7)	Launcher Chute	P-3

(8)	Lighting Control Panel	P-3
(9)	Transfer Ballast Pump and Hose	ON PRIOR NAVY AIRSHIPS
(10)	In-flight Refueling Connection and Stop Valve	LAMPS
(11)	UWT Hydrophone and Cable	commercially available

d. Hull Mounted Equipment — Current Use

(1)	Stern Zoom Television Camera	commercially available
(2)	Rescue Hatch Zoom Television Camera	commercially available
(3)	Active-Gated Television/LASER Illumination (AGTV)	COAST GD
(4)	Underside External Floodlights	P-3
(5)	KS-87 Aerial Camera	COAST GD
(6)	Underside External Loudspeakers	S-2
(7)	AN/APS-127 Forward Looking Radar (FLAR)	COAST GD
(8)	AN/APS-94 Side Looking Radar (SLAR)	COAST GD

B. CREW STATIONS AND EQUIPMENT UNIQUE TO COAST GUARD SAR

1. Crew Stations

There are three crew stations for the SAR (Coast Guard) configuration: pilot, communicator/navigator, and SAR rescue crewman. Coast Guard SAR procedures differ slightly from Navy SAR procedures, principally in the rescue equipment used. The pilot and communicator/navigator positions are the same as the Baseline configuration. The SAR rescue crewman station is located aft. All stations are illustrated in Figure 9.

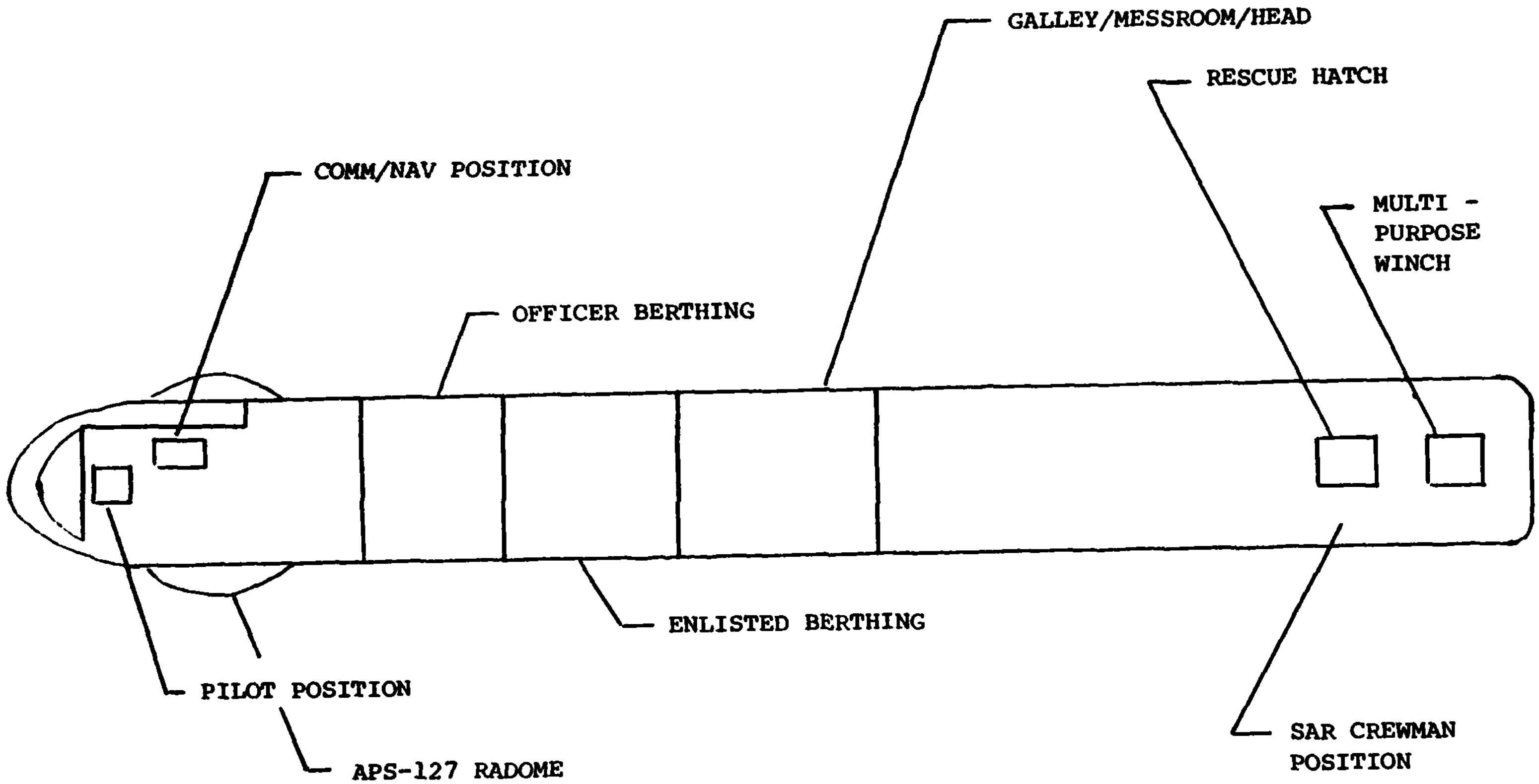


Figure 9 SAR Configuration

2. Equipment

a. Aft Crew Station	Current Use
(1) Portable Damage Control Equipment (fire fighting gear, dewatering pumps, damage control tool rolls)	COAST GD
(2) Rescue Basket	COAST GD

C. CREW STATIONS AND EQUIPMENTS UNIQUE TO ASW

1. Crew Stations

There are three crew stations for the ASW configuration: pilot, communicator / navigator, and ASW sensor operator. The pilot and communicator/navigator positions are the same as the Baseline configuration. The ASW sensor operator station is aft. The ASW sensor operator deploys/recovers the array and operates the IAIRTASS avionics. During replenishment he is assisted by the airship cook in stowing stores. All stations are illustrated in Figure 10. The IAIRTASS equipment is illustrated in Figure 11.

2. Equipment

a. Pilot Station	Current Use
(1) BTR (Bearing Time Recorder) ANAC Model 910 or equivalent	IAIRTASS
(2) Environmental Display Panel - heading (converted to true) - depth (feet) - temp. (deg. F) - speed (kts.)	IAIRTASS

b. Communicator/Navigator Station	Current Use
(1) BTR ANAC Model 910 or equivalent	IAIRTASS
(2) Environmental Display Panel	IAIRTASS

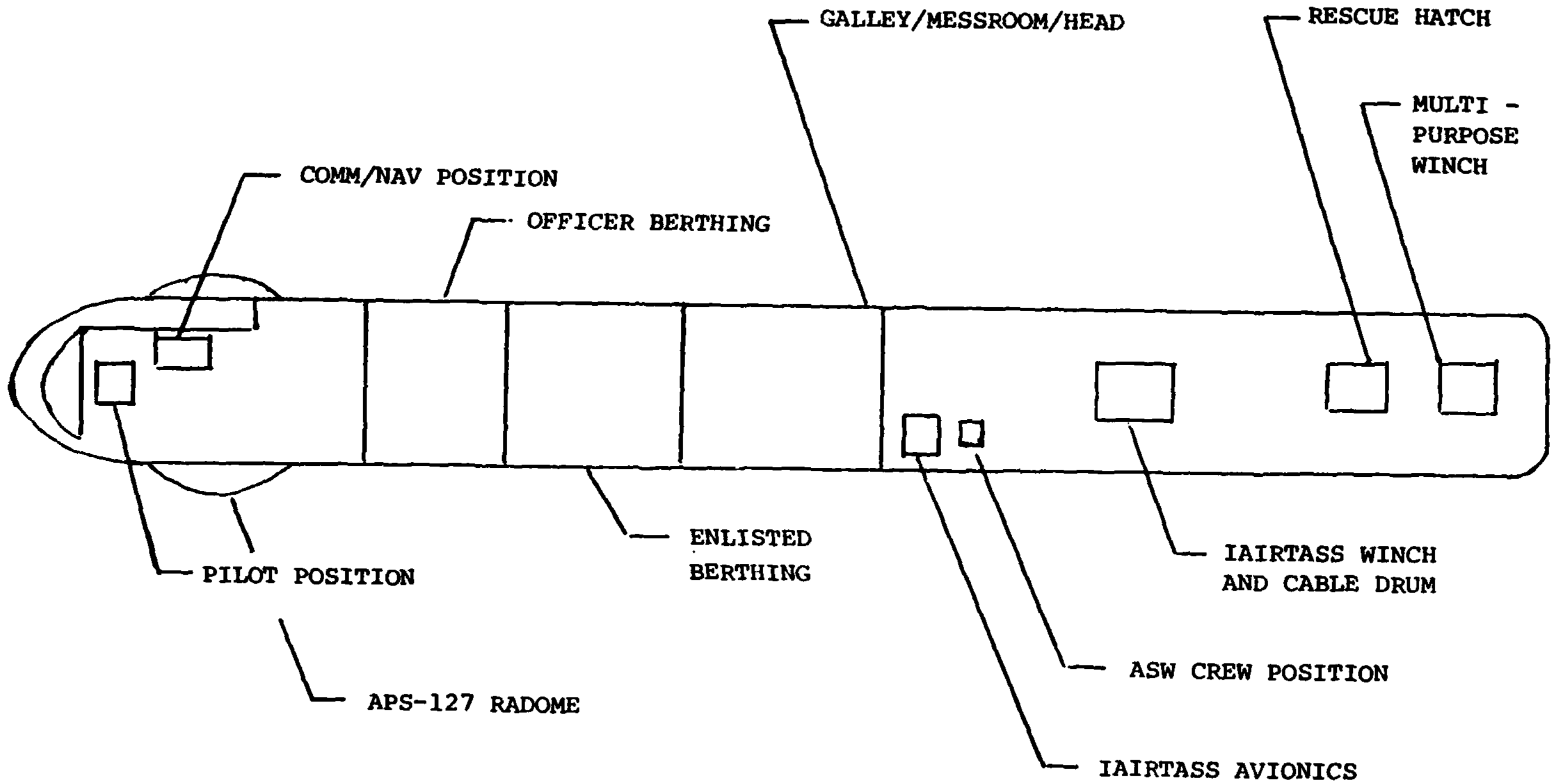


Figure 10 ASW Configuration

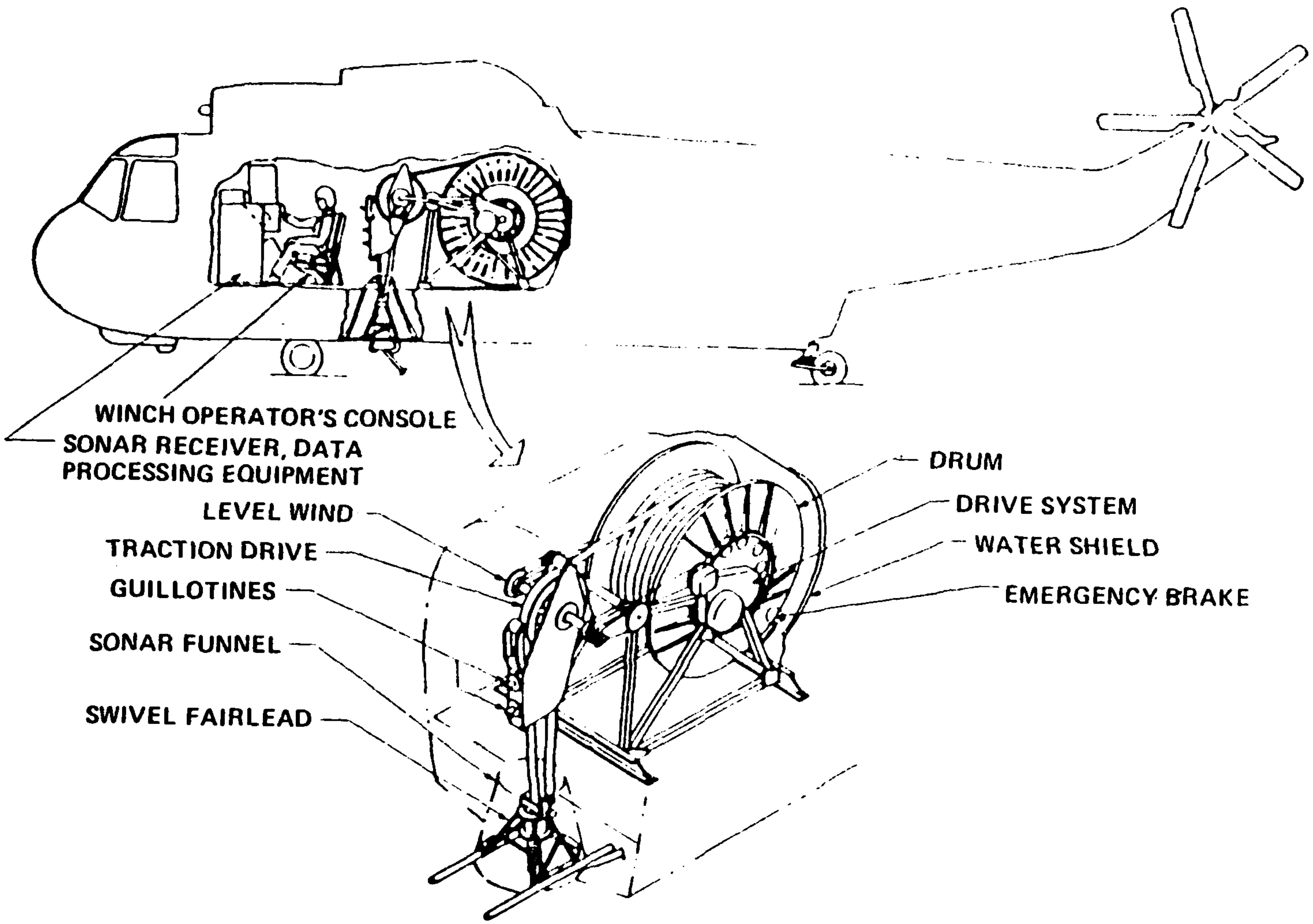


Figure 11 IAIRTASS Equipment Installation

- heading (converted to true)
- depth (feet)
- temp. (deg. F)
- speed (kts.)

(3) AN/ASQ-81 MAD (Magnetic Anomaly Detection) — LAMPS

c. ASW Sensor Operator Station — Current Use

IAIRTASS (Interim Airborne Towed Array Sonar System)

(1) AN/SQR-15 TASS Sonar System — IAIRTASS

- avionics console

(a) BTR (Bearing Time Recorder)
(b) WAP II
(c) Environmental Display Panel

  - heading (converted to true)
  - depth (feet)
  - temp. (deg. F)
  - speed (kits.)

(d) Cable Tension Indicator
(e) Cable Footage Indicator
(f) Winch Control
(g) Emergency Brake Switch

- winch assembly

- array assembly

- cable

(2) Recorder - Reproducer — IAIRTASS

(3) Data Relay (data link) — IAIRTASS

(4) MK-46 torpedoes (3) — ORDNANCE

(5) AN/SSQ-36 Bathythermograph — P-3

D. CREW STATIONS AND EQUIPMENTS UNIQUE TO AMCM

1. <u>Crew Stations</u>

There are seven crew stations for the AMCM configuration: pilot, communicator/navigator, crew chief, and four

crewmembers who assemble and disassemble the minesweeping gear. The pilot and communicator/navigator positions are the same as the Baseline configuration. The five AMCM crewmen are stationed aft. The crew chief is at the winches and acts as safety observer. Crewman #1 and crewman #2 are all the way aft. Crewman #3 and crewman #4 are slightly forward. Crewman #2 is the petty officer in charge. All stations are illustrated in Figure 12.

2. Equipment

a. Aft Crew Station	Current Use
(1) Beacon Transponders (air launchable)	NEW DESIGN
(2) MK 103 AMCM Minesweeping Kit (Floats, Otters, Cutter Assemblies, Cable, Depressors, Locking Ball, and Winches)	RH-53D

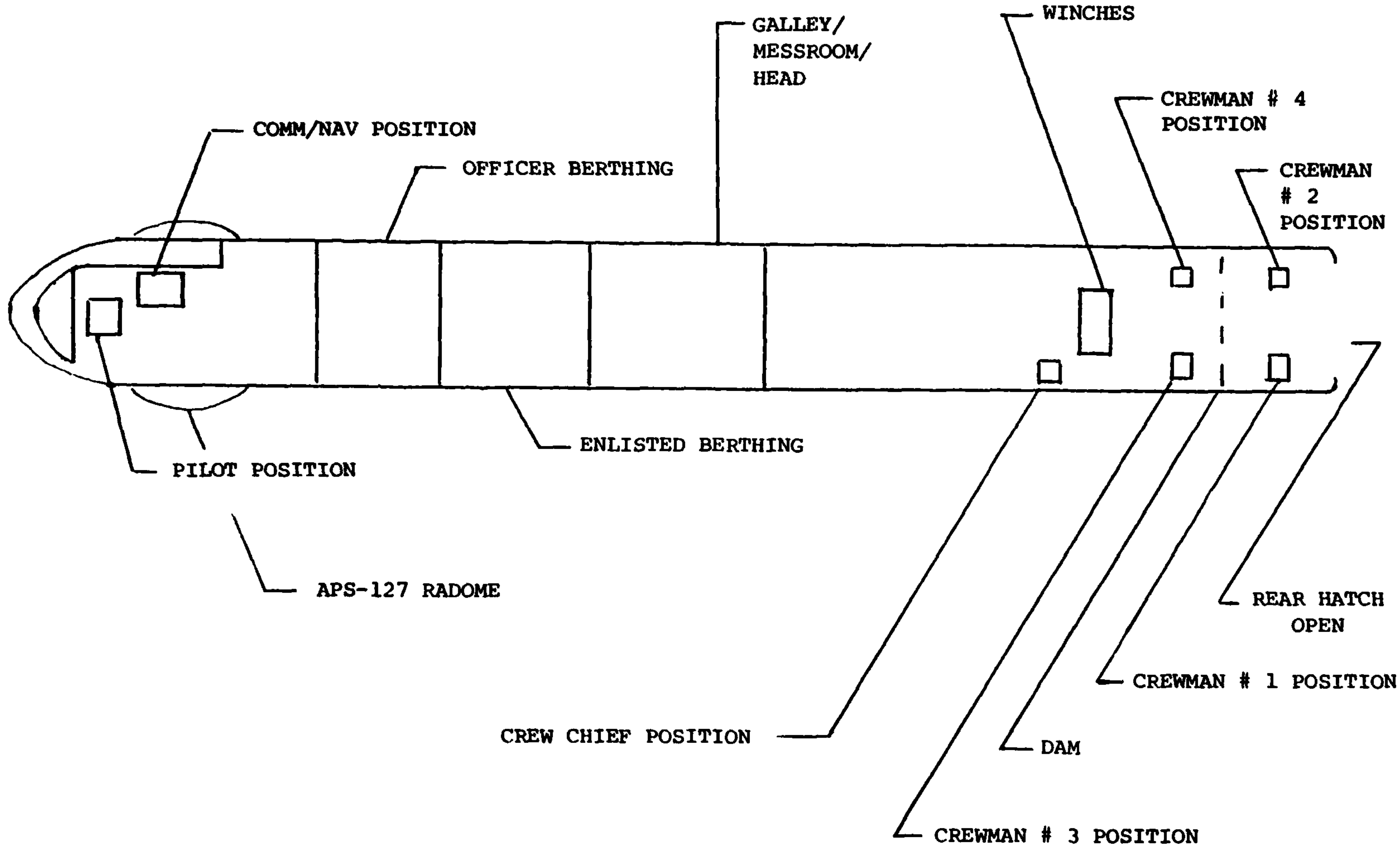


Figure 12 AMCM Configuration

V. CONCLUSIONS

A. BASELINE SCENARIO

The analysis shows that it is feasible for 2 personnel, a pilot and a communicator/navigator, to operate the airship during launch, cruise out, cruise back, and landing, given the use of automated control systems.

B. SAR OPERATIONS

The analysis shows that it is feasible for 3 personnel, pilot, communicator/navigator, and 1 crewmember at the after station, to operate the airship during SAR operations. If the mission is projected to last for more than 10 to 12 hours a second section of 3 personnel would be required. Additional manpower (1 to 3 personnel) is required if it is necessary to board a vessel in distress or to enter the water to assist survivors. The analysis, however, shows that the launch segment requires 1 hour and 56 minutes. This is an excessive response time for SAR requirements. It is possible that launch segment tasks could be modified, e.g., complete fine erection of the navigation system en-route and conduct preflight inspections prior to start of the mission, to conform to SAR response requirements.

C. ASW OPERATIONS

The analysis shows that it is feasible for 3 personnel, pilot, communicator/navigator, and ASW sensor operator to

operate the airship during ASW operations. A fourth crewmember is required during airship in-flight-replenishment operations. Although not a part of the analysis, the requirement for a rigger/cook on board is obvious; and the duties of the fourth crewmember during in-flight-replenishment were assigned to the rigger/cook. Assuming three sections of watchstanders, this equates to an ASW crew of 10.

D. AMCM OPERATIONS

The analysis shows that it is feasible for seven personnel, pilot, communicator/navigator, and 5 crewmembers at the after station, to operate the airship during airborne mine countermeasures operations.

E. EQUIPMENT

It was shown in the thesis that it is possible to equip the Maritime Patrol Airship with off-the-shelf equipment that results in significant reductions in manning.

VI. SUGGESTED TOPICS FOR FURTHER RESEARCH

A. GROUND HANDLING CREW

Analyze the manpower requirements for the ground handling crew. This has never been accomplished.

B. SKILL LEVELS AND TRAINING REQUIREMENTS

No work was done in this thesis to determine skill levels. This is the prerequisite to determine training requirements and programs. After skill levels are determined an analysis should be made to see if there exist sufficient numbers of personnel with these skills. If there are, can they be recruited from other programs or must they be recruited from outside the military?

C. SOURCES FOR PILOTS

Is it feasible to create a community of warrant officer and enlisted pilots? Must all pilots be commissioned officers? Is it adequate to have one commissioned officer on board as airship commander?

D. REMAINING COAST GUARD MISSIONS

There are six more Coast Guard missions that have not been analyzed (Enforcement of Laws and Treaties, Marine Environmental Protection, Aids to Navigation, Port Safety and Security, Marine Science Activities, and Ice Operations).

E. ASM ARMAMENT

The airship has not been provided with an air to surface weapon to attack a surfaced submarine or a surface ship. What would be a suitable weapon? Sea Skua is a possibility.

F. MODS TO FF/FFG ESCORTS

What modifications could be designed for at sea temporary enlargement of the helo deck on FF/FGG type ships? In the event of serious casualty to the airship operating in the ASW scenario some provision should be made to land on a surface escort for emergency repairs.

G. HABITABILITY

What are the environmental factors peculiar to an airship that affect crew performance? What standard of habitability should be met? Will motion sickness be a problem?

H. MAINTENANCE PERSONNEL

What would the maintenance personnel requirements be for this conceptual design? Would less automation reduce maintenance manpower costs sufficiently to make larger operating crews desirable? Can the operating organization (Coast Guard or Navy) recruit sufficiently trainable maintenance personnel? Is contractor support required?

I. GREATER AUTOMATION

Advanced technology (F-18 program) could enable the pilot to assume the communication and navigation functions.

Is this desirable? What are: the maintenance impacts, the training impacts, or the recruiting impacts?

J. SURFACE ESCORT FUEL CAPACITIES

Are all surface escorts capable of carrying sufficient fuel to refuel airships in an ASW scenario? What would be the fuel requirements for variable numbers of ASW escorts over specified routes? Can the surface ships be modified if necessary? Would it be necessary to provide a tanker for the airships, as well as the one presently required for the surface ships?

K. EFFECTS OF SALT WATER ON ENGINES

When operating within 100 feet of the ocean surface it is possible for aircraft engines to ingest salt water spray or mist. Certain of the airship scenarios, particularly SAR and ASW, call for the airship to operate at a 100 foot altitude for long periods. Research should be conducted to determine if this is a limiting factor. If it is, is there some means of overcoming the problem?

L. CREW TRANSFERS DURING OCEAN TRANSITS

Analyze the options of transferring operating crews at sea as opposed to carrying adequate personnel on board for an ocean transit. What are the weight costs of providing adequate habitability for multiple crews on board the airship? Are they greater than the costs of added personnel for relief crews?

APPENDIX A. TASK ANALYSIS AND TIME LINE ANALYSIS FOR COMMON ELEMENTS (LAUNCH, CRUISE OUT, CRUISE BACK, LAND) AND FOR COAST GUARD SAR ON STATION OPERATIONS

A. FORMAT OF THE TASK ANALYSIS

1. Crewmember positions always appear first in each task descriptive statement. These are abbreviated as:

P = pilot

CN = communicator/navigator

CM1 = crewman number 1

CM2 = crewman number 2

2. If several (but not all) crewmembers are to perform a given item, then the letters indicating which are separated by a comma, as:

P, CN 0050 Monitor fuel gauge.

If one <u>or</u> the other (but not necessarily both) are to perform a given item, then:

P/CN 0060 Enter posit in CDP.

B. FORMAT OF THE TIME LINE ANALYSIS

1. The time line analysis for the events on each page of the task analysis is contained on the succeeding page. Events can be identified by the corresponding Task Numbers.

2. Events proceed from the bottom to the top of each page of the time line analysis. Elapsed time is annotated at the top of the page proceeding from left to right. The reader should note that the elapsed time scale is not constant. The scale expands and contracts to correspond to the events contained on each page of the task analysis.

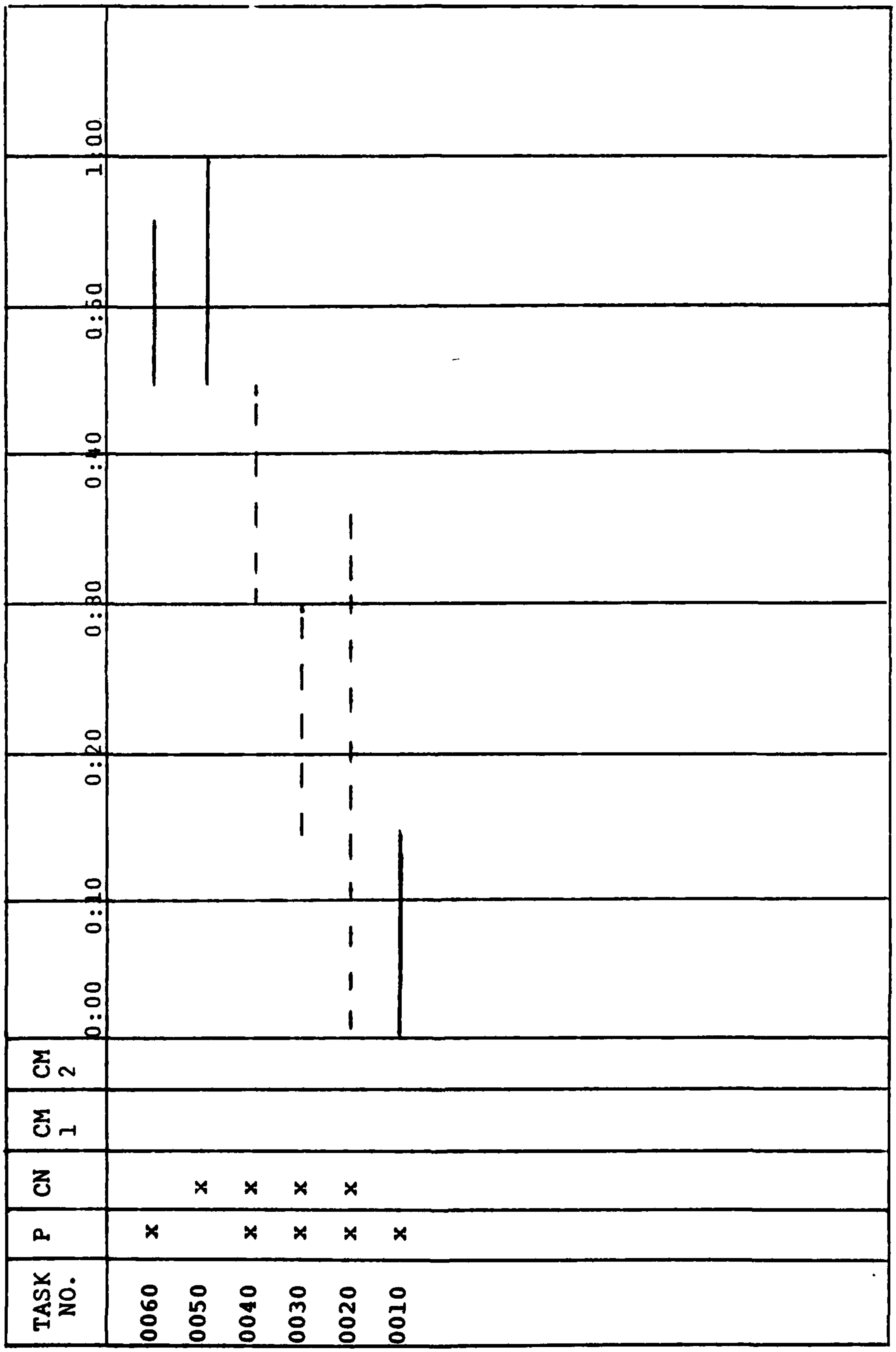
3. The time line analysis has vertical columns containing the event Task Number and the crewmembers. An X in a crewmember column indicates that the task is performed by the indicated crewmember. If more than one crewmember is involved in the task, each one who is involved will be indicated.

4. A solid horizontal line across the page indicates the duration the crewmember(s) is(are) occupied. A dashed line signified that one <u>or</u> the other (but not necessarily both) of two crewmmebers are to perform the task. Extremely short tasks of this type, however, will appear to have a solid line.

SEGMENT 1 - LAUNCH

The SAR crew prelights the airship. Upon notification of a SAR mission the SAR crew mans the airship, starts up and warms the engines, and takes off negatively buoyant (dynamic take off). Once airborne the airship comes to the course for the designated search area and climbs to cruise altitude. The tasks involved are:

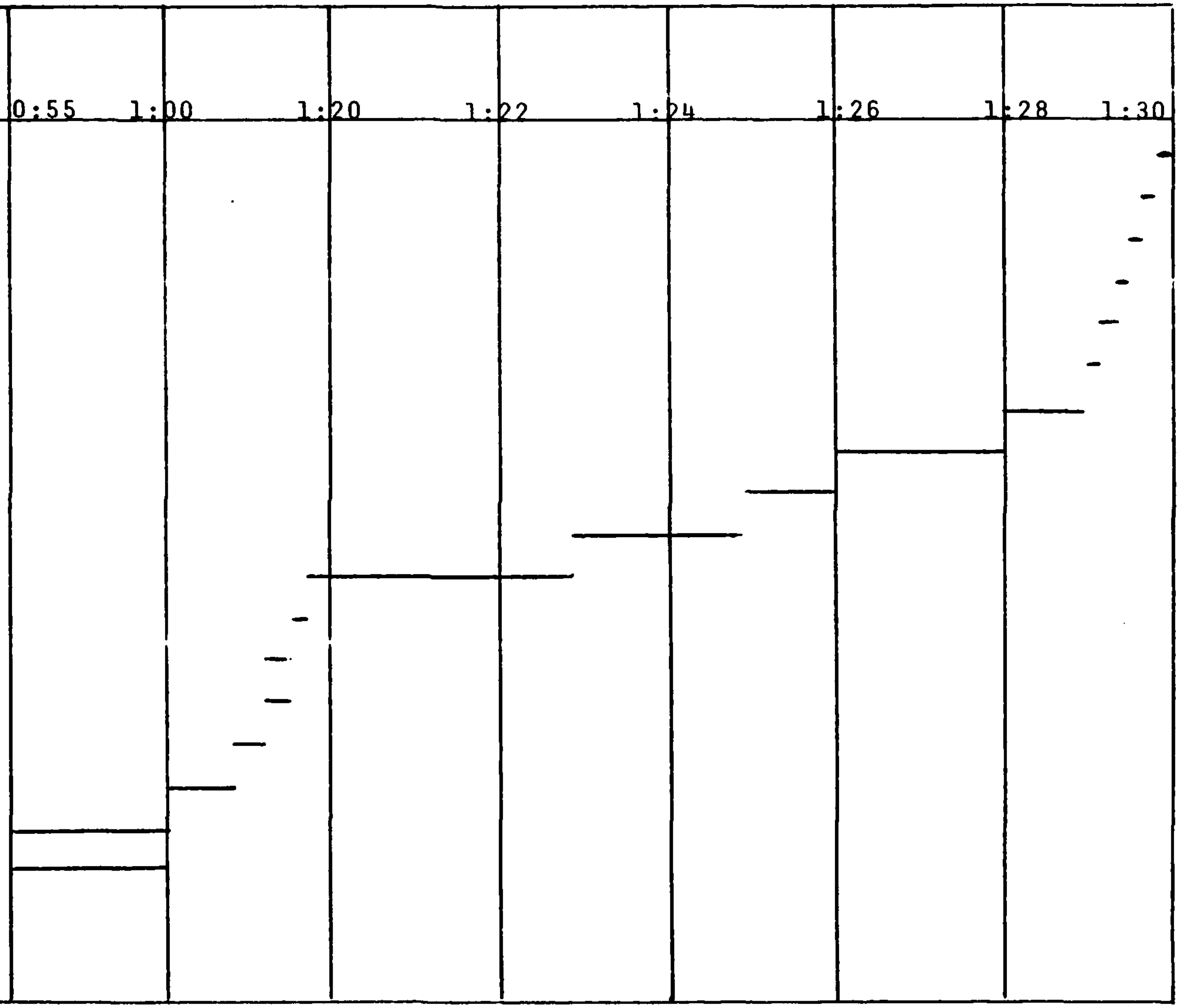
Crew-member	Task No.	Task Title
PREMISSION ACTIVITY		
P	0010	Complete airship equivalent of weight and belance form (DD 365F)
P/CN	0020	Complete controlling technical agency's required preflight inspection.
P/CN	0030	Complete equivalent to "Yellow Sheet" OPNAV FORM 3760/2 (Naval Aircraft Flight Records).
P/CN	0040	Complete Coast Guard equivalent of "Preflight/Daily/In-Flight" maintenance record OPNAV FORM 4790/38.
END PREMISSION ACTIVITY		
INSPECTIONS AND READINESS CHECKS		
CN	0050	Prepare flight plan.
P	0060	Complete pilot's "walkaround" of the airship.



TASK NO.
P
CN
CM 1
CM 2
0:00
0:10
0:20
0:30
0:40
0:50
1:00
0060
0050
0040
0030
0020
0010
x

P	0070	Verify and sign flight plan.
P,CN	0080	Receive weather brief.
CN	0090	File flight plan.
P/CN	0100	Deliver all required flight documentation to ground crew lineman.
ALL	0110	Check personal survival gear.
CN	0120	Brief crew and any passengers on ditching stations (as assigned during preflight and posted).
CN	0130	Brief crew and any passengers on mission, weather, and ground emergencies.
CN	0140	Verify miscellaneous equipment stowed.
P,CN	0150	Take seats, adjust seats, and harness.
P,CN	0160	Perform smoke mask check (optional).
P,CN	0170	Don headsets and test ICS operation.
P	0180	Initiate Before Start Checklist.
P	0190	Start APU.
P	0200	Select ground air conditioning.
P,CN	0210	Set interior and instrument panel lights as desired.
P	0220	Check fuel and ignition switches correctly set.
P	0230	Check fire detectors.

TASK NO.	P	CN	CM 1	CM 2
0230	x			
0220	x			
0210	x	x		
0200	x			
0190	x			
0180	x			
0170	x	x		
0160	x	x		
0150	x	x		
0140		x		
0130		x		
0120		x		
0110	x	x	x	x
0100	x	x		
0090		x		
0080	x	x		
0070	x			
0050		x		



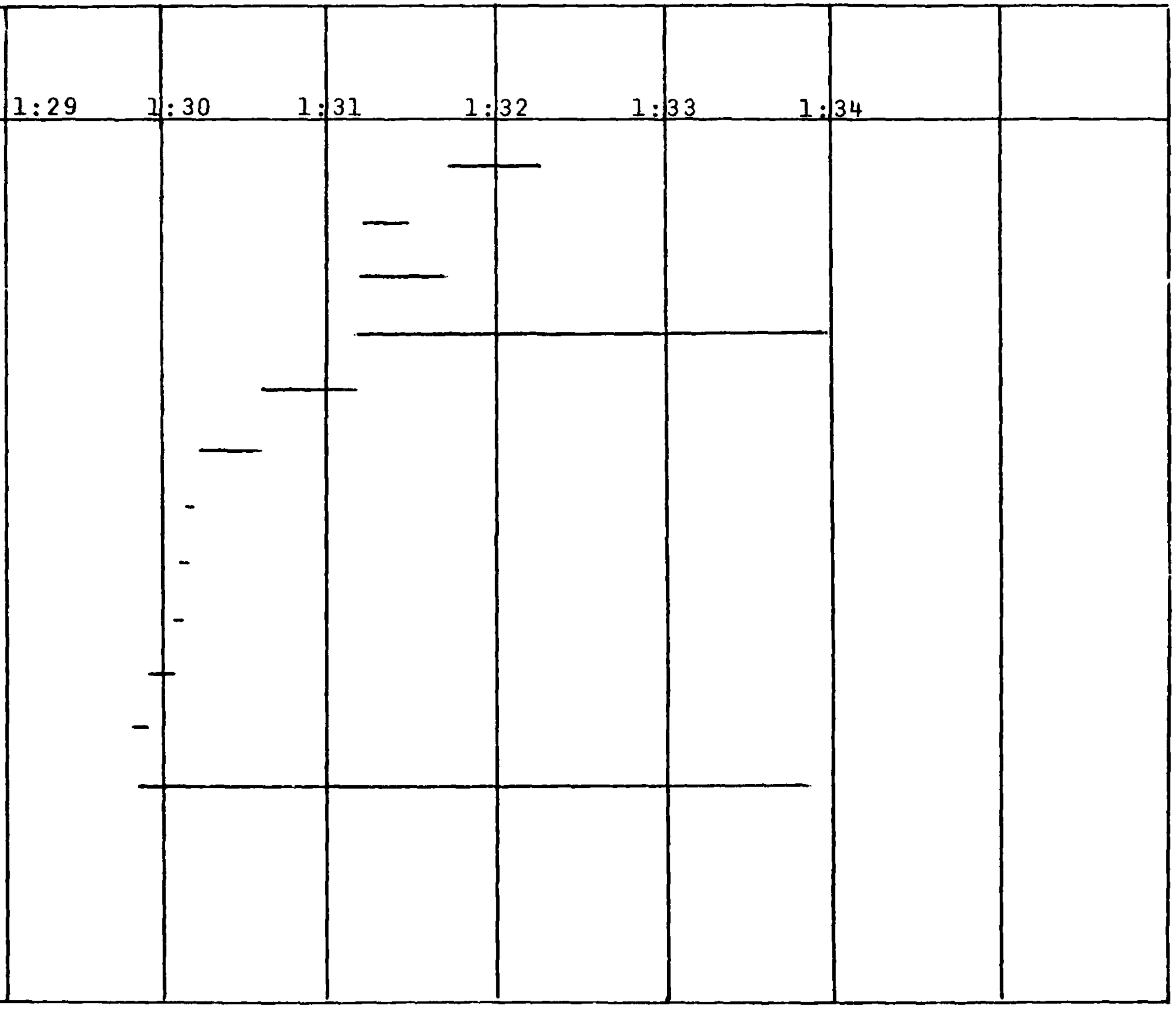
CN	0240	Enter data in CPC via CDP to commence airship navigation system erection.
CN	0250	Activate radar altimeters.
P	0260	Verify disposable ballast or board.
P	0270	Verify mission stipulated fuel load.
P	0280	Verify desired fuel system valve configuration.
P	0290	Activate external rotating airship beacons.

END INSPECTIONS AND READINESS CHECKS

START ENGINES

P	0300	Conduct comm check on ICS with outside observer (outside observer connects into ICS by plugging phone cable into externally mounted phone jack).
P	0310	Brief crew to monitor outside observer for stern engine start.
P	0320	Pilot monitor outside obs for No. 1 and No. 2 engine starts.
P	0330	Brief crew to announce prop rotation for stern engine when signalled by outside observer.
CN	0340	Radio check with ground control.
P	0350	Obtain visual clearance from outside obs for first engine start (normally stern engine).

TASK NO.	P	CN	CM 1	CM 2
0350	x			
0340		x		
0330	x			
0320	x			
0310	x			
0300	x			
0290	x			
0280	x			
0270	x			
0260	x			
0250		x		
0240		x		



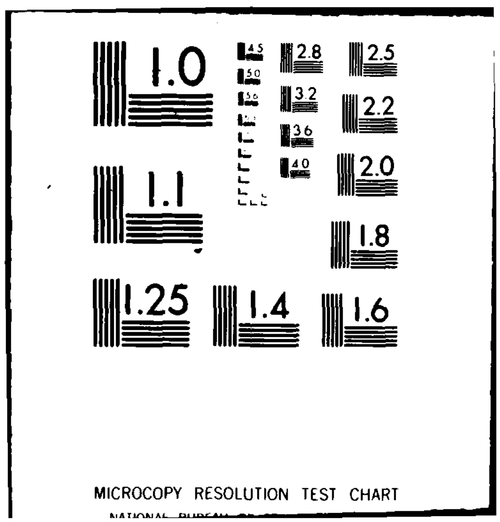
AD-A085 144 NAVAL POSTGRADUATE SCHOOL MONTEREY CA F/G 15/2

PERSONNEL AND EQUIPMENT DESIGN CONCEPT FOR A MARITIME PATROL AI--ETC(U)

DEC 79 T C MCGINLAY

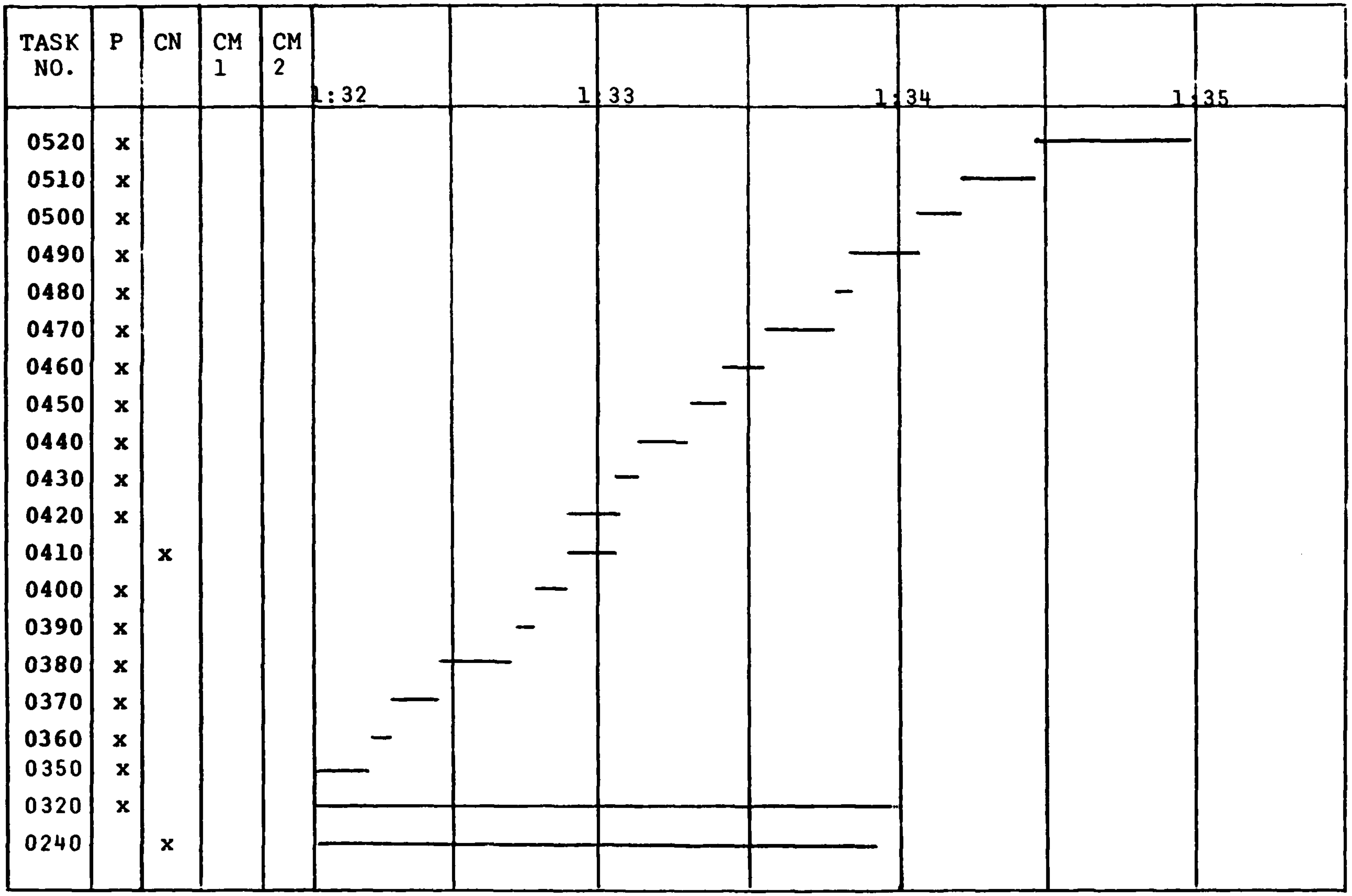
UNCLASSIFIED NL

2 of 3


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART

P	0360	Visually check No. 1 and No. 2 engines <u>clear</u>.
P	0370	Receive report from outside observer that stern engine is <u>clear</u>.
P	0380	Start stern engine.
P	0390	Receive report of prop rotation on stern engine.
P	0400	Verify normal engine operating parameters.
CN	0410	Start mission clock (input to CPC via CDP).
P	0420	Announce "Normal Start on Stern" to ground crew via ICS.
P	0430	Visually check No. 1 and No. 2 engines still <u>clear</u>.
P	0440	Start No. 1 engine.
P	0450	Observe prop rotation on No. 1 engine.
P	0460	Verify normal engine operating parameters.
P	0470	Announce "Normal start on No. 1" to ground crew via ICS.
P	0480	Visually check No. 2 engine still <u>clear</u>.
P	0490	Start No. 2 engine.
P	0500	Observe prop rotation on No. 2 engine.
P	0510	Verify normal engine operating parameters.
P	0520	Announce "Normal start on No. 2" to ground crew via ICS.

END OF START ENGINES


TASK NO.
P
CN
CM 1
CM 2
1:32
1:33
1:34
1:35
0520 x
0510 x
0500 x
0490 x
0480 x
0470 x
0460 x
0450 x
0440 x
0430 x
0420 x
0410 x
0400 x
0390 x
0380 x
0370 x
0360 x
0350 x
0320 x
0240 x

AFTER START CHECK LIST

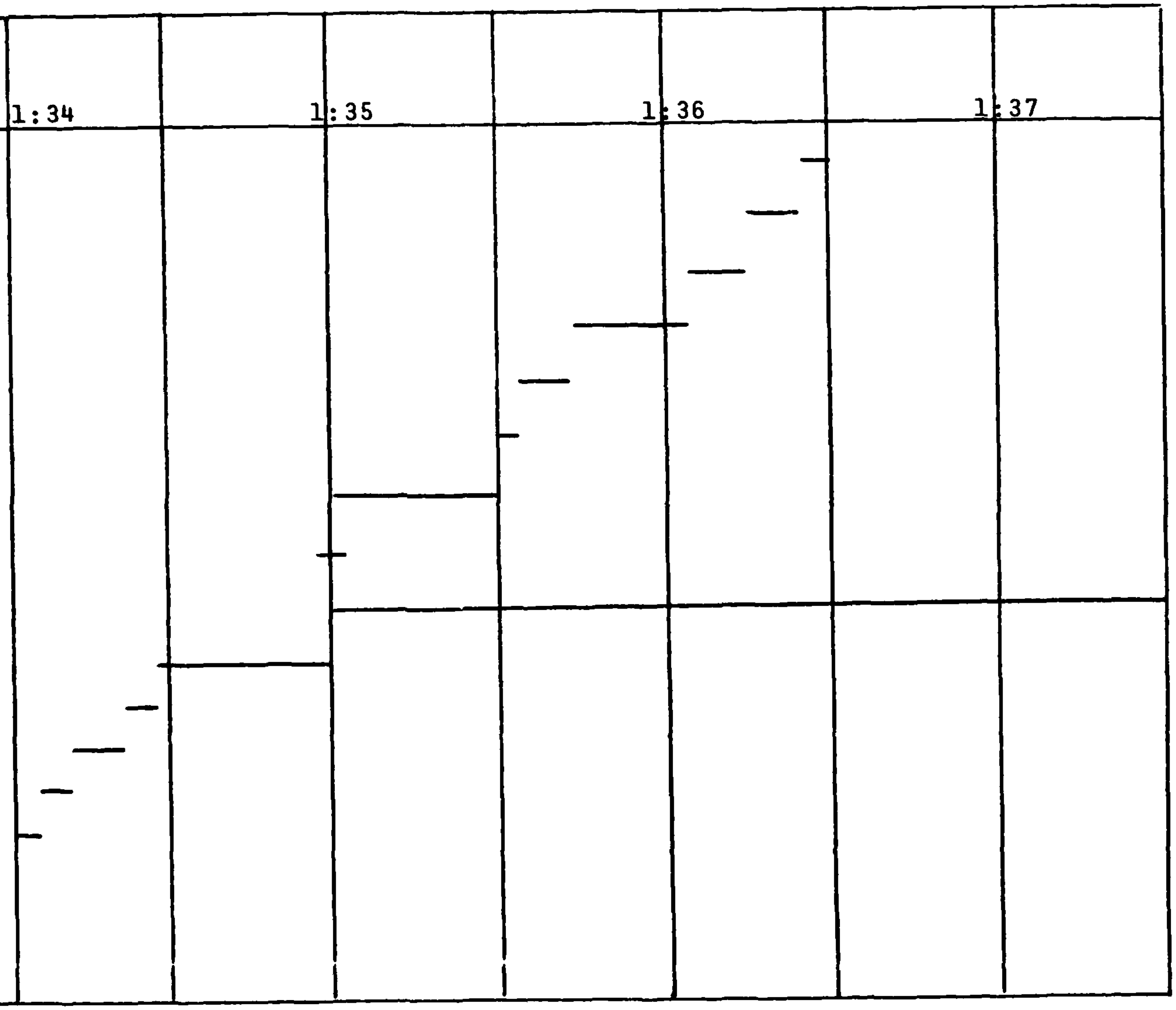
CN	0530	Verify all control car doors shut and locked.
CN	0540	Conduct run around relay checks.
CN	0550	Inform P run around relay checks in progress.
P	0560	Activate hydraulic power units (HPUs).
P	0570	Observe normal hydraulic pressure output from each HPU.
P	0580	Order ground crew to observe operation of ruddevators.
P	0590	Move right hand controller forward and back, screw clockwise and counterclockwise.
P	0600	Receive report from ground crew that ruddevators operate.
P	0610	Shift from ground air conditioning to air ship air conditioning.
CN	0620	Bring IFF unit to standby

END OF AFTER START CHECKLIST

RELEAST FROM MAST

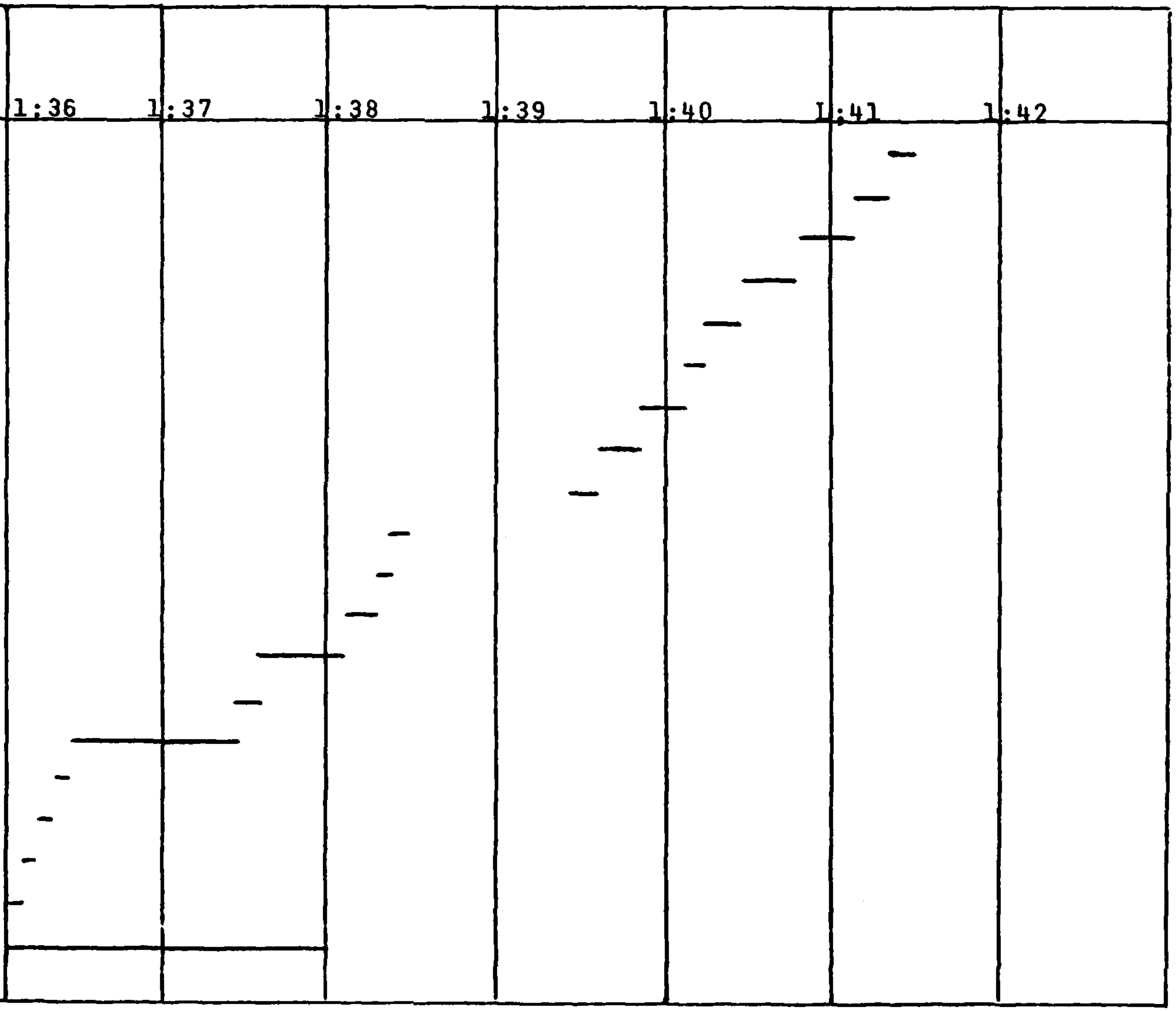
NOTE: EVEN A VECTORED THRUST AIRSHIP IS LIKELY TO HAVE DIFFICULTIES IN TAXING FREELY TO THE TAKE-OFF POSITION. IT WILL PROBABLY HAVE TO BE MOVED TO THE CLOSE VICINITY OF THE TAKE OFF POSITION ON THE MAST, UNMASTED, AND THEN TAKE OFF ALMOST IMMEDIATELY.

TASK NO.	P	CN	CM 1	CM 2
0620		x		
0610	x			
0600	x			
0590	x			
0580	x			
0570	x			
0560	x			
0550		x		
0540		x		
0530		x		
0520	x			
0510	x			
0500	x			
0490	x			



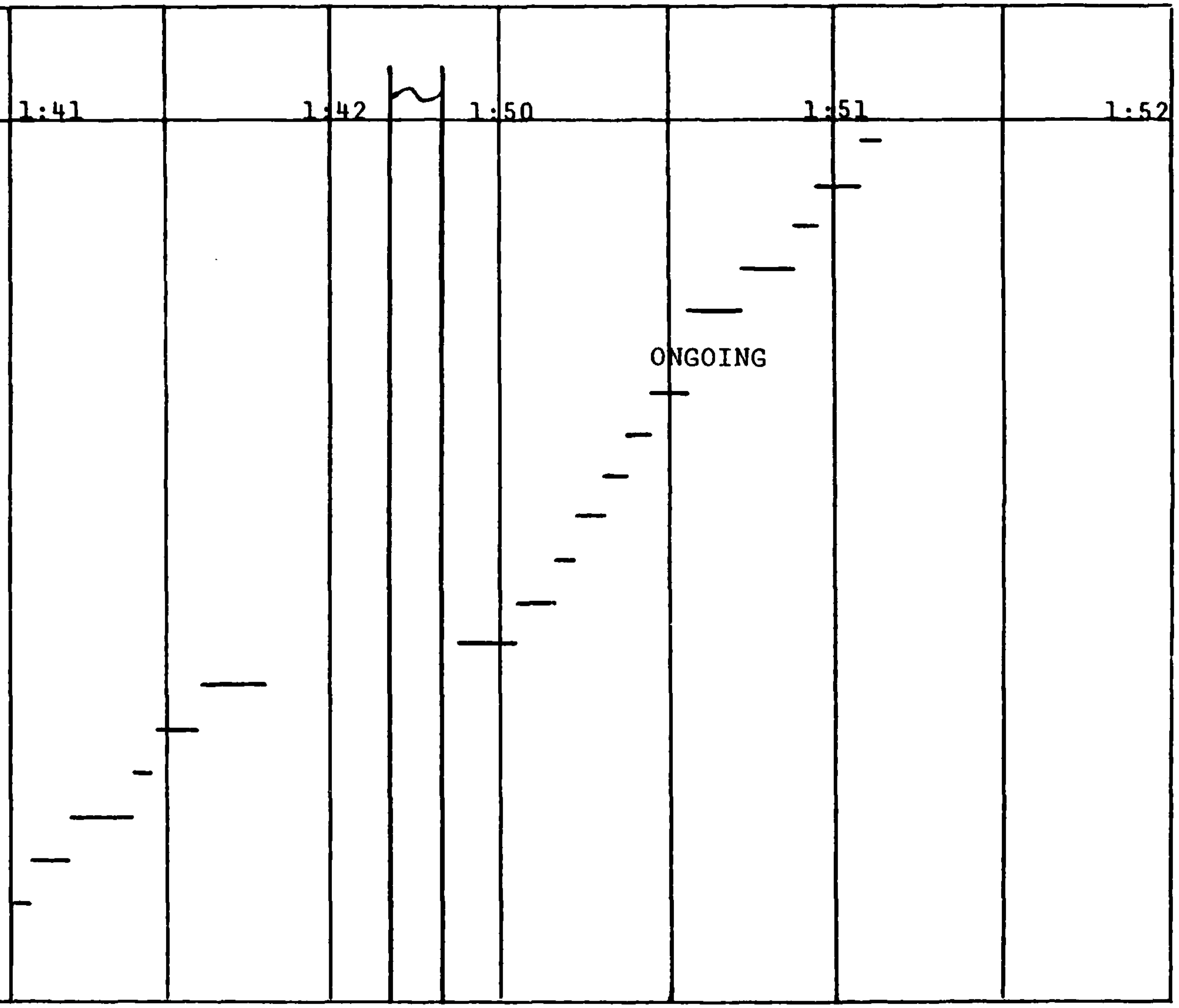
P	0630	Conduct anti-ice checks.
P	0640	Announce "Prepare to unmast" on AS/PA system.
P	0650	Set barometer pressure on altimeter.
P	0660	Enter barometer pressure in CPC via the computer control and display panel (CDP).
P	0670	Verify indicated altitude ± 75 feet of field elevation.
P	0680	Verify normal electrical system operation.
CN	0690	Set initial outbound course into CPC via the CDP.
(If VOR is primary departure NAVAID)		
CN	0700	Select VOR 1 (tuned and identified) for HSI bearing and course.
CN	0710	Select VOR 2 (tuned and identified) for HSI bearing and course.
CN	0720	Verify TACAN (tuned and identified) is available for DME and backup to VORS.
CN	0730	Select UHF No. 1 primary radio. (NOTE: UHF No. 2 available as backup.)
CN	0740	Setup intersections using VOR No. 2.
(If VOR is not primary departure NAVAID)		
CN	0750	Select as required inputs for HSL bearing and course.
CN	0760	Set Comm Freq in accord with SID or assigned DEP freqs.
P,CN	0770	Check seating harnesses.

TASK NO.	P	CN	CM 1	CM 2
0770	x	x		
0760		x		
0750		x		
0740		x		
0730		x		
0720		x		
0710		x		
0700		x		
0690		x		
0680	x			
0670	x			
0660	x			
0650	x			
0640	x			
0630	x			
0620		x		
0610	x			
0600	x			
0590	x			
0540		x		



P	0780	If no icing conditions exist, verify anti/de-ice system off.
P	0790	If icing conditions exist, activate anti/de-ice system.
CN	0800	Select assigned code and mode for IFF/SIF.
CN	0810	Verify satisfactory airship navigation system erection.
CN	0820	Compare heading indications for primary and secondary inputs.
CN	0830	Select primary source for compass heading input.
P/CN	0840	Compare attitude indications for primary and secondary inputs.
CN	0850	Select primary source for attitude indicator input.
P	0860	Activate landing and taxi lights.
P	0870	Contact ground control for release from mast clearance.
CN	0880	Guard int'l distress freq.
P	0890	Visually check clear sides.
P	0900	Inform ground crew "Prepare to unmast. Standby for down thrust" on ICS.
P	0910	Verify in HOVER regime.
P	0920	Receive report from lineman "Ready to unmast. Clear for down thrust" on ICS.
P	0930	Execute low power down thrust with left hand controller.

TASK NO.	P	CN	CM 1	CM 2
0930	x			
0920	x			
0910	x			
0900	x			
0890	x			
0880		x		
0870	x			
0860	x			
0850		x		
0840	x	x		
0830		x		
0820		x		
0810		x		
0800		x		
0790	x			
0780	x			
0770	x	x		
0760		x		
0750		x		



P 0940 Order ground crew "Unmast" on ICS.

P 0950 When airship has been released from mast and mast rolled clear, order ground crew to disengage external phone cable.

P 0960 Slowly release down thrust with left hand controller.

END RELEASE FROM MAST

TAKE OFF

P 0970 Line up airship with centerline of runway.

P 0980 Receive take off clearance from tower.

CN 0990 Set departure comm frequency.

P 1000 Move left hand controller full forward and counter-clockwise for max forward and up thrust.

P 1010 Verify max power on thrust indicators.

P 1020 Position airship to required nose up angle for take off with right hand controller.

P 1030 Verify safely airborne.

P 1040 Notify DEP control when airborne.

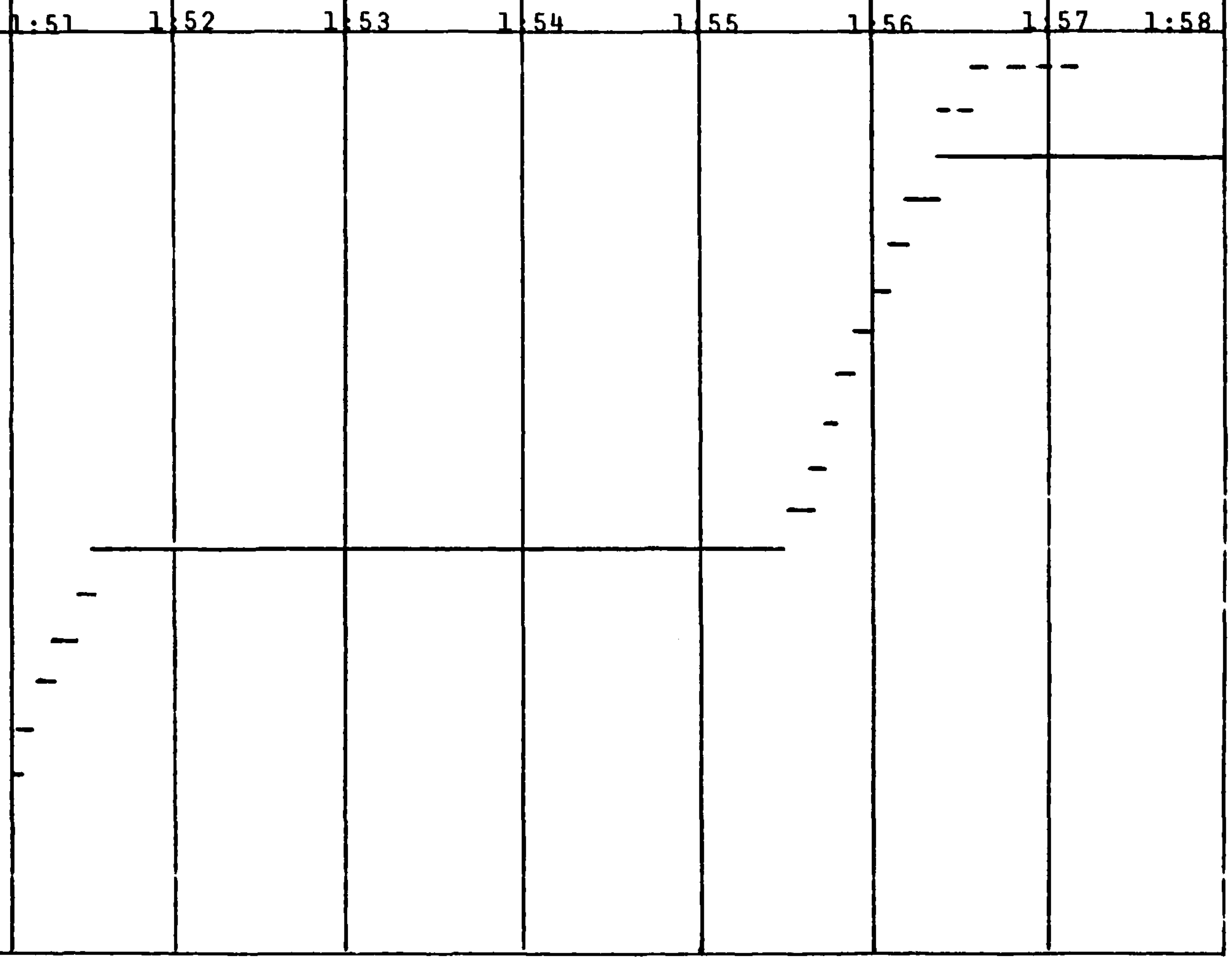
P 1050 Receive instructions from departure control.

P 1060 Maneuver AC IAW departure clearance (SID, radar, visual).

P/CN 1070 Receive assigned control agency freq from DEP cont.

P/CN 1080 Contact control agency.

TASK NO.	P	CN	CM 1	CM 2
1080	x	x		
1070	x	x		
1060	x			
1050	x			
1040	x			
1030	x			
1020	x			
1010	x			
1000	x			
0990		x		
0980	x			
0970	x			
0960	x			
0950	x			
0940	x			
0930	x			
0920	x			



CN	1090	Receive, copy and record clearance instructions. Insure pilot understands clearances.
CN	1100	Set nav/comm freqs.
CN	1110	Set IFF/SIF as required, transmit as required.
P	1120	Set HSI course select as required.
P	1130	Maneuver AC as required to adhere to clearance.
CN	1140	Monitor int'l distress freq.
END OF TAKE OFF		
CLIMB		
CN	1150	Radiate APS-127 forward looking radar (FLAR).
P	1160	Secure landing and taxi lights.
P	1170	Bring airship to desired climb attitude.
P	1180	Maintain flight conditions.
P	1190	Monitor rate of climb.
P	1200	Scan externally.
P	1210	Monitor attitude, speed, and altitude.
P	1220	Bring airship to cruise altitude (5,000 feet).
P	1230	Level off at 5,000 feet.
P/CN	1240	Acknowledge and take action on computer generated alarms and equipment status reports.

TASK NO.	P	CN	CM 1	CM 2	1:57	1:58	1:59	2:00	2:01	2:02	2:03 – 2:04
1240	x	x									ONGOING
1230	x										
1220	x										
1210	x							ONGOING			
1200	x							ONGOING			
1190	x							ONGOING			
1180	x							ONGOING			
1170	x										
1160	x										
1150		x									
1140		x					ONGOING				
1130	x						ONGOING				
1120	x										
1110		x									
1100		x									
1090		x									
1080	x	x									
1060	x										

P	1250	Throttle back on left hand controller to maintain 90 kts air speed. Lock left hand controller at required setting.
CN	1260	Guard int'l distress freq.
P	1270	Secure the APU.

END OF CLIMB

END OF SEGMENT 1 - LAUNCH

SEGMENT 2 - CRUISE OUT

The airship cruises at 5,000 feet at 90 kts to the designated search area. The tasks involved are:

Crew-member	Task No.	Task Title
P	1280	Comm to FAA controller.
P	1290	Receive handoff from departure controller to FAA controller.
P	1300	Turn to heading for search area.
P	1310	Advise controller.
P	1320	Receive flight route clearance.
P	1330	Maneuver AS as necessary to conform to flight plan.
CN	1340	Change communication frequencies as directed.
CN	1350	Change NAV freq as necessary.
CN	1360	Change IFF codes as directed.

TASK NO.	P	CN	CM 1	CM 2	2:03	2:04	2:05	2:06	2:07		
1360		x						ONGOING			
1350		x						ONGOING			
1340		x						ONGOING			
1330	x							ONGOING			
1320	x										
1310	x										
1300	x										
1290	x										
1280	x										
1270	x										
1260		x			ONGOING						
1250	x										
1230	x										

P	1370	Enable autopilot.
P	1380	Verify fuel transfer and sequencing.
P	1390	Maintain attitude.
CN	1400	Enter desired arrival posit (lat/long) for commencement of search in CPC.
CN	1410	Enable inputs to CPC from most favorable source (NAVSAT, OMEGA, or other NAVAID) via the CDP.
CN	1420	Order airship navigation system to steer for desired arrival posit.
P	1430	Maintain 5,000 foot altitude.
CN	1440	Note posit report/time to go advisory messages from AS NAV system.
P	1450	Comm report to designated controller for course changes.
P	1460	Receive adknowledgment.
CN	1470	Guard int'l distress freq.
P	1480	Monitor fuel status.
P/CN	1490	Monitor radar display.
P	1500	Scan externally.
P	1510	Comm report to FAA controller when at desired search commencement point.
P	1520	Receive acknowledgment.

TASK NO.	P	CN	CM 1	CM 2	2:07	2:08	2:09		2:25	2:26		
1520	x											
1510	x											
1500	x					ONGOING						
1490	x	x				ONGOING						
1480	x					ONGOING						
1470		x				ONGOING						
1460	x					ONGOING						
1450	x					ONGOING						
1440		x				ONGOING						
1430	x					ONGOING						
1420		x										
1410		x										
1400		x										
1390	x				ONGOING							
1380	x				ONGOING							
1370	x											

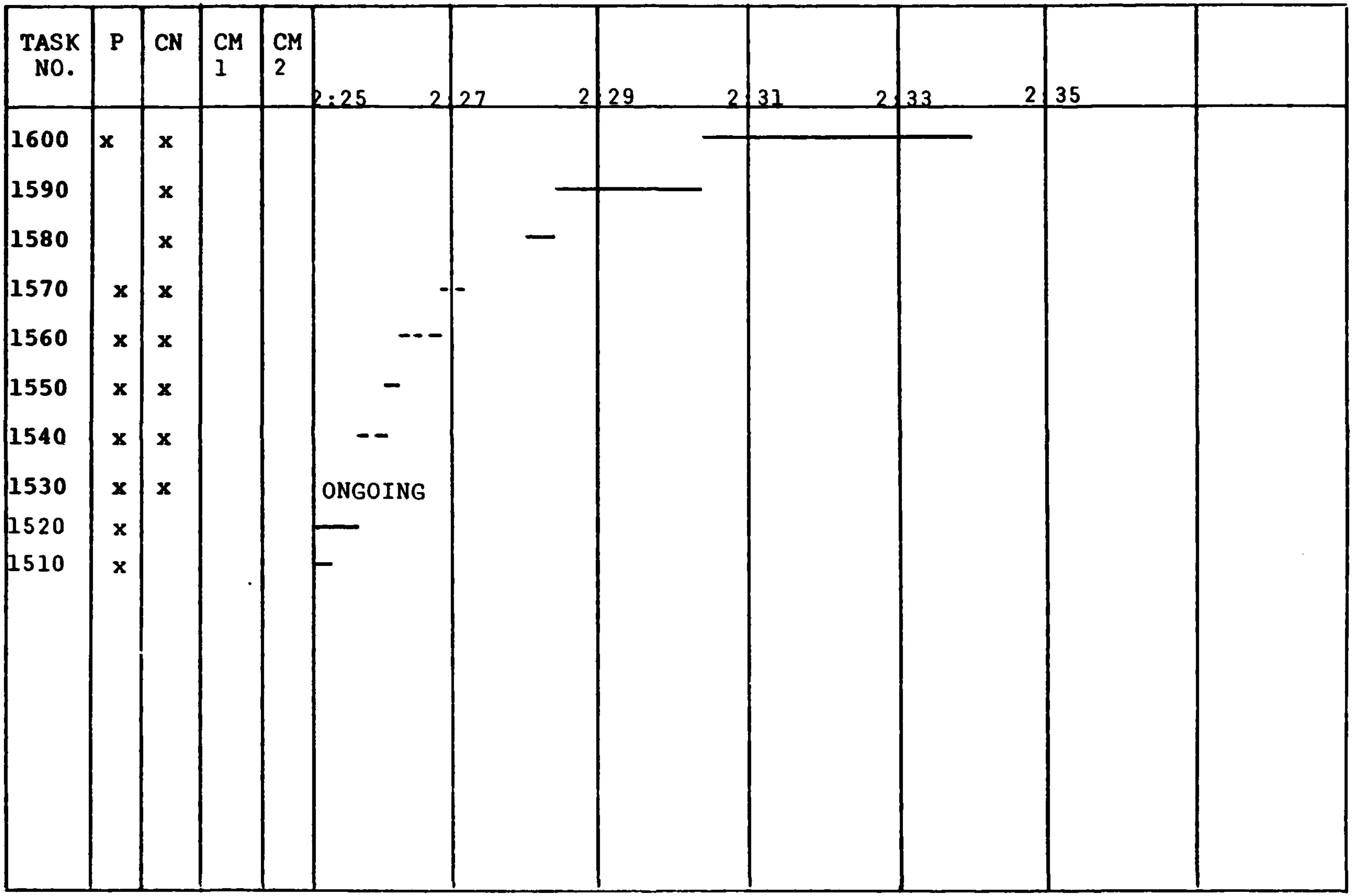
P/CN	1530	Acknowledge and take action on computer generated alarms and equipment status reports.
P/CN	1540	Comm report to on scene SAR commander (if present).
P/CN	1550	Receive acknolwedgement.
P/CN	1560	Make SITREP to SAR control center.
P/CN	1570	Receive acknowledgment.

END SEGMENT TWO - CRUISE OUT

SEGMENT 3 - ON STATION OPERATIONS

Search. Upon reaching search commencement point the airship slows to 60 kts and commences desired search pattern. The side scanning radars (SLAR) are activated and radar and visual search is conducted. Navigation positions from the airship navigation system (computer synthesis of OMEGA, NAVSAT, other radio NAVAIDS and inertial inputs) are printed on the SLAR output via the CPC. The tasks involved are:

Crew-member	Task No.	Task Title
CN	1580	Activate side scan radars (SLAR).
CN	1590	Input into CPC via the CDP: sea state, wind, area weather, their effects on the sensors, object of search (man, life raft, vessel) projected movement, and last known contact area/posit.
P,CN	1600	Evaluate search pattern proposed by CPC.


TASK NO.
P
CN
CM 1
CM 2
2:25
2:27
2:29
2:31
2:33
2:35
1600 x x
1590 x
1580 x
1570 x x
1560 x x
1550 x x
1540 x x
1530 x x
ONGOING
1520 x
1510 x

CN	1610	Enter CPC search pattern or modification into CPC via CDP.
P	1620	Verify electronic altimeter and doppler velocity radar altimeters operating correctly and outputs are being received by CPC.
P	1630	Set altitude desired (5,000 feet) into CPC via the CDP.
P	1640	Ensure actual altitude is 5,000 ± 100 feet.
P	1650	Engage altitude hold.
P	1660	Enable auto nav mode of airship nav system via CDP.
P	1670	Order airship nav system to maintain speed of 60 kts via CDP.
P	1680	Enable flare/smoke release mechanism.
P/CN	1690	Monitor FLAR display.
CN	1700	Monitor SLAR output.
P	1710	Investigate FLAR/SLAR contacts.
CN	1720	Guard int'l distress freq.
P	1730	Maintain visual surveillance (external).
P	1740	Comm report to designated control agency of course changes.
P	1750	Receive acknowledgment.
P	1760	Monitor fuel status.
P/CN	1770	Acknowledge and take action on computer generated alarms and equipment status reports.

TASK NO.	P	CN	CM 1	CM 2	2:33	2:34	2:35	2:36	2:37	2:38	2:39 2:40
1770	x	x							ONGOING		
1760	x								ONGOING		
1750	x								ONGOING		
1740	x								ONGOING		
1730	x								ONGOING		
1720		x							ONGOING		
1710	x								ONGOING		
1700		x							ONGOING		
1690	x	x							ONGOING		
1680	x										
1670	x										
1660	x										
1650	x										
1640	x										
1630	x										
1620	x										
1610		x									
1600	x	x									

P	1780	Release flare/smoke when object of search sighted.
P	1790	Comm report to SAR control upon sighting.
P	1800	Receive acknowledgment.
P	1810	Disengage auto nav mode of airship nav system.
P	1820	Disengage altitude hold.
CN	1830	Secure SLAR.

END OF SEARCH

Discussion. As was explained in the general overview of this scenario, there are five possible elements of the Coast Guard SAR Mission:

(1) rescued persons may be taken directly on board the airship,

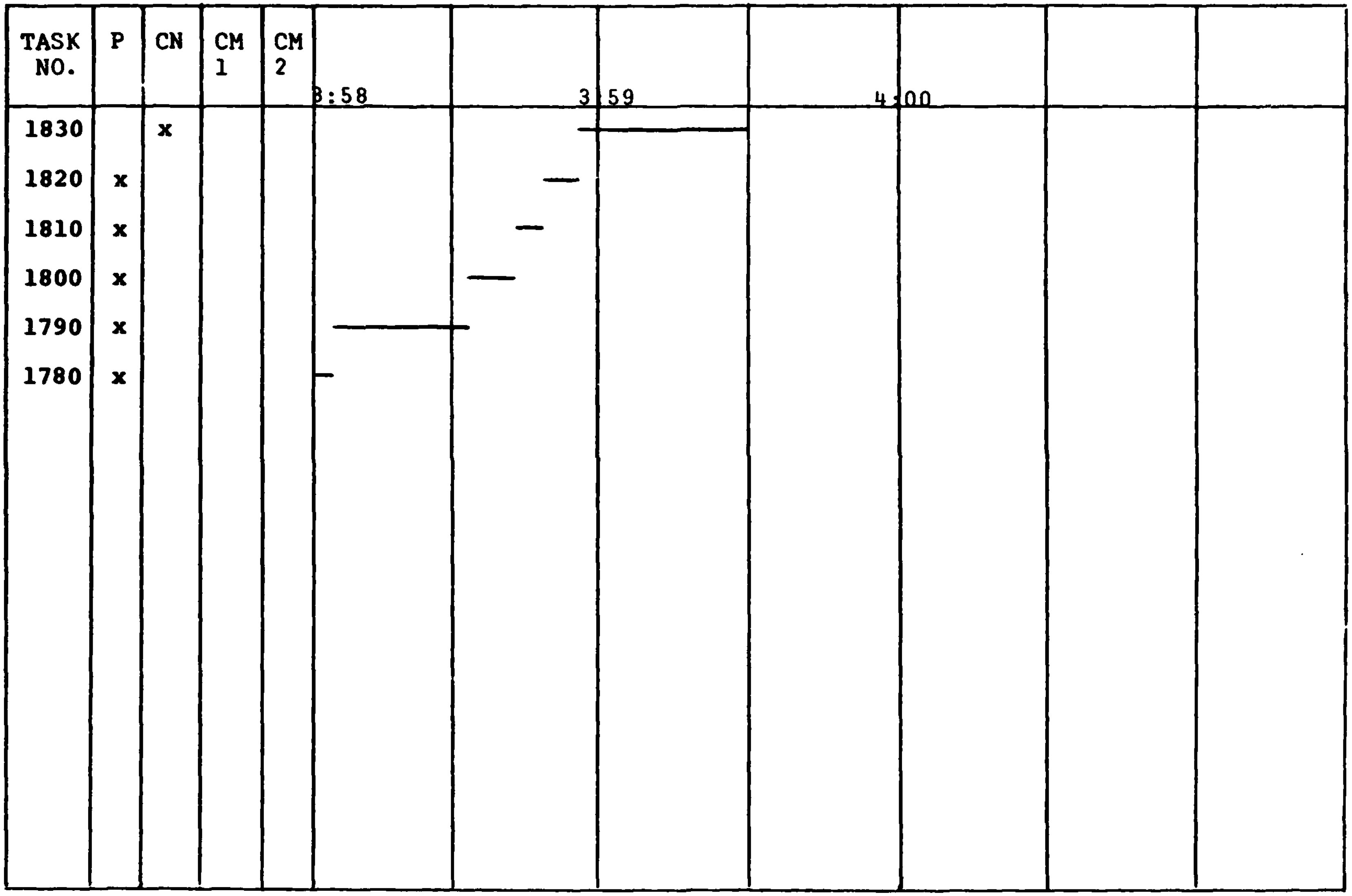
(2) the airship crew may fight fire aboard an endangered vessel,

(3) the airship crew may fight flooding aboard an endangered vessel,

(4) a disabled vessel may be towed by the airship,

(5) the airship may serve as an on-scene command center and search platform in multiunit operations.

The most complex flow of events would involve a vessel in distress which requires the airship to render assistance (equipment and/or personnel) followed by towing the distressed vessel. Accordingly this scenario will develop the tasks required for rendering assistance to and towing a distressed vessel. Additionally this scenario will develop


TASK NO.
P
CN
CM 1
CM 2
3:58
3:59
4:00
1830
1820
1810
1800
1790
1780
x
x
x
x
x
x

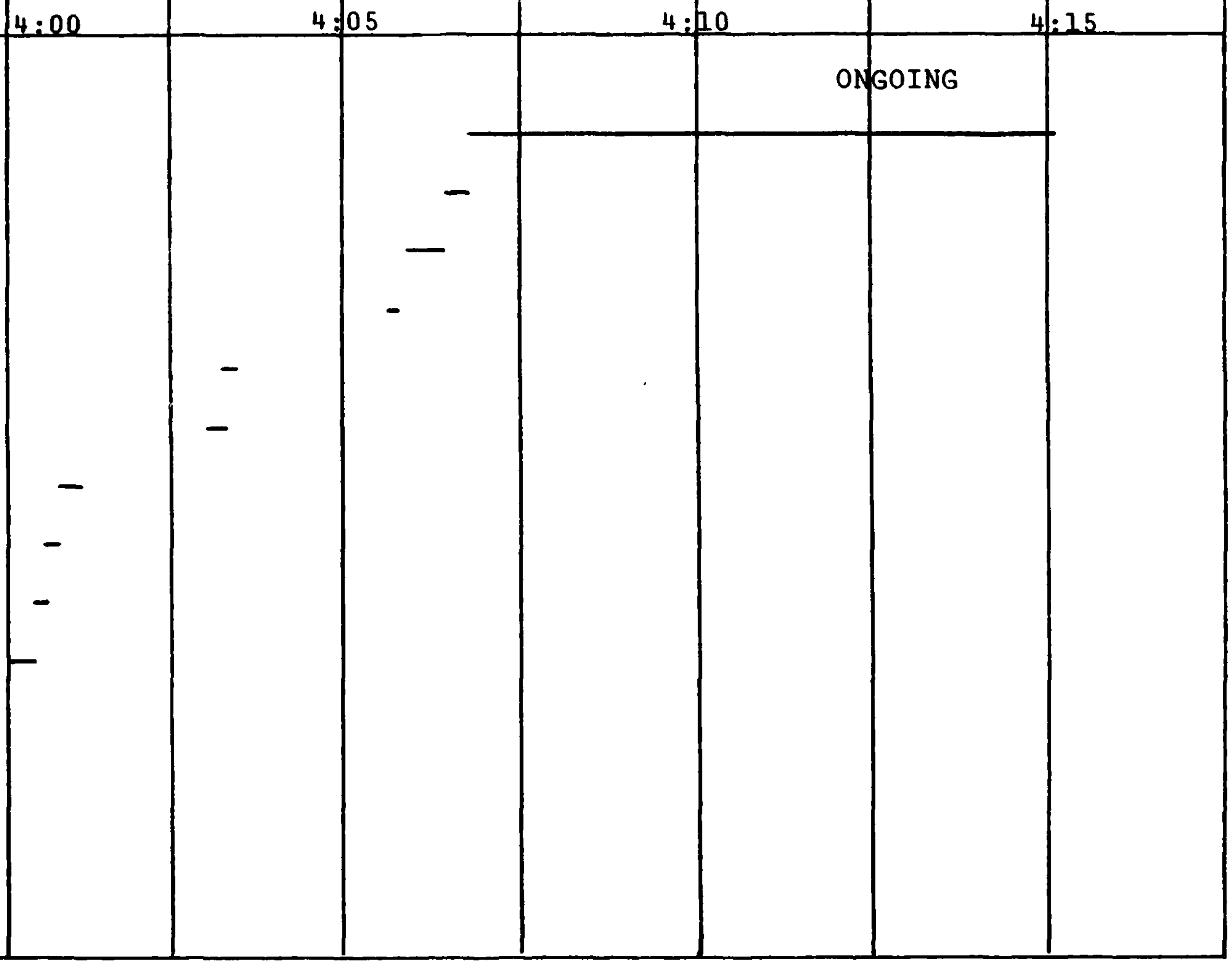
the tasks required for recovery of survivor(s) in the water since this is also a manpower intensive evolution.

RENDERING ASSISTANCE AND TOWING A SMALL VESSEL IN DISTRESS

The tasks involved are:

Crew-member	Task No.	Task Title
DESCEND TO 100 FEET		
P	1840	Request designated control agency clearance to descend to 100 feet.
P	1850	Receive clearance.
P	1860	Alert crew on ICS/PA that airship will descend.
P	1870	Position airship to optimum descent angle.
P	1880	Commence leveling out when passing 2,000 feet (6 ship lengths).
P	1890	Reduce speed.
P	1900	Level out at 100 feet, slow to speed no greater than 35 kts.
P	1910	Report altitude to designated control agency.
P	1920	Receive acknowledgment.
CN	1930	Attempt to communicate with distressed vessel by radio. Ascertain conditions.
CN	1940	Guard int'l distress freq.

TASK NO.	P	CN	CM 1	CM 2
1940		x		
1930		x		
1920	x			
1910	x			
1900	x			
1890	x			
1880	x			
1870	x			
1860	x			
1850	x			
1840	x			



P/CN	1950	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.

END DESCENT

HOVER

P	1960	Shift from CRUISE to HOVER regime.
P	1970	Hover airship at 100 feet in vicinity of distressed vessel.
P/CN	1980	If radio comms with distressed vessel were unsuccessful, attempt to communicate via airship's externally mounted loudspeakers via PA system.
P,CN,CM1	1990	If comms still unsuccessful, hover over distressed vessel and lower hand held transceiver. Attempt to arrange radio comms.
CM1	2000	Lower emergency damage control equipment (Rescue Equipment, Dewatering Pump, and Firefighting Equipment Set) to distressed vessel. Total weight of lowered equipment is 281 pounds.
CM1	2010	Lower rescue and assistance party (two men at 200 lbs/man).
P	2020	Remain in hover regime and move airship laterally clear of distressed vessel.
P	2030	Maintain 100 foot altitude.
CM1	2040	Lower water ballast transfer hose into ocean.
P	2050	Transfer sufficient water ballast into airship ballast tanks to compensate for weight of equipment/ personnel lowered to distressed vessel.

TASK NO.	P	CN	CM 1	CM 2	4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00
2050	x											
2040			x									
2030	x											
2020	x											
2010			x									
2000			x									
1990	x	x	x									
1980	x	x										
1970	x											
1960	x											
1950	x	x			ONGOING							

CM1	2060	Recover water ballast transfer hose.
P/CN	2070	Guard int'l distress freq.
P	2080	Monitor fuel status.
P	2090	Scan externally.
P	2100	Maintain flight conditions
P/CN	2110	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
END HOVER		
LOITER		
P	2120	Verify RAWS and doppler velocity radar altimeter operating correctly and outputs are being received by CPC.
P	2130	Set altitude desired (100 feet) into CPC via the CDP.
CN	2140	Set racetrack pattern around distressed vessel into CPC via the CDP.
P	2150	Ensure actual altitude is 100 feet ± 5 feet.
P	2160	Engage altitude hold.
P	2170	Enable auto nav mode of airship nav system. Order speed of 35 kts.
P/CN	2180	Report position and orbit to designated control agency.
P/CN	2190	Receive acknowledgment.
P/CN	2200	Make situation report to SAR center and receive acknowledgement.

TASK NO.	P	CN	CM 1	CM 2	5:56	6:00	6:05	6:10	6:15		
2200	x	x									
2190	x	x									
1280	x	x									
2170	x										
2160	x										
2150	x										
2140		x									
2130	x										
2120	x										
2110	x	x			ONGOING						
2100	x				ONGOING						
2090	x				ONGOING						
2080	x				ONGOING						
2070	x	x			ONGOING						
2060			x								

P/CN	2210	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
P	2220	Monitor fuel status.
CN	2230	Guard int'l distress freq.
P	2240	Scan externally.
CN	2250	Maintain comms with distressed vessel.
P	2260	Monitor attitude, speed, and altitude.
P	2270	Monitor heading.
P	2280	Maintain flight conditions.
P	2290	Ascertain when conditions on distressed vessel permit commencement of towing operation (casualties under control).

END LOITER

HOVER

P	2300	When distressed vessel is ready to be towed, prepare to return to vessel.
P	2310	Disengage auto nav mode of airship nav system.
P	2320	Disengage altitude hold.
P	2330	Return to vicinity of bow of distressed vessel and hover in this position.
CM1	2340	Pass messenger line to distressed vessel by lowering or with shot line.

TASK NO.	P	CN	CM 1	CM 2	6:15	6:30	6:45	7:00	7:15	7:30	
2340			x								
2330	x										
2320	x										
2310	x										
2300	x										
2290	x										
2280	x				ONGOING						
2270	x				ONGOING						
2260	x				ONGOING						
2250		x			ONGOING						
2240	x				ONGOING						
2230		x			ONGOING						
2220	x				ONGOING						
2210	x	x			ONGOING						

P	2350	Display stern TV camera on P and CP TV monitors to monitor tow line and tow. Adjust zoom as required.
CM1	2360	Connect messenger line to tow line.
CM1	2370	Pay out tow line from stern of airship with hydraulic winch.
CM1	2380	Cease paying out tow line upon visual signal or radio comms from distressed vessel.
CM1	2390	Secure airship winch for towing.
P	2400	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
P	2410	Monitor fuel status.
CN	2420	Guard int'l distress freq.
P	2430	Scan externally.
P	2440	Maintain altitude.
P/CN	2450	Receive report from distressed vessel that tow line is secured on deck and vessel is ready for towing operation to commence.
END HOVER		
TOW		
P	2460	Verify electronic altimeter and doppler velocity radar altimeter operating correctly and outputs are being received by CPC.
P	2470	Set altitude desired (100 feet) into CPC via the CDP.

TASK NO.	P	CN	CM 1	CM 2	7:30	7:35	7:40	7:45	7:50	7:55	
2470	x										
2460	x										
2450	x	x									
2440	x							ONGOING			
2430	x							ONGOING			
2420		x						ONGOING			
2410	x							ONGOING			
2400	x							ONGOING			
2390			x								
2380			x								
2370			x								
2360			x								
2350	x										

P	2480	Receive report from CM1 in stern of control car that towing winch has been checked ready for towing.
P	2490	Remaining in HOVER regime, come slowly to desired heading, or one best suited to sea conditions, and slowly increase speed to 6 kts or lower if dictated by sea state. Rate of yaw and rate of speed increase will be determined by towing conditions.
P	2500	Maintain 100 foot altitude.
CN	2510	When on desired heading and desired speed (less than or equal to 6 kts), enter this course and this speed into CPC via the CDP as an auto nav leg. Enable auto nav mode of airship nav system.
P	2520	Engage altitude hold.
P	2530	Shift from HOVER to CRUISE regime.
P/CN	2540	Report posit, heading, and speed to controlling agency at prescribed intervals while towing.
P/CN	2550	Receive acknowledgments.
P/CN	2560	Make situation reports to SAR control cneter at prescribed intervals. Request surface towing vessel to meet and take over tow.
P/CN	2570	Receive acknowledgment.
P/CN	2580	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
P	2590	If tow line tension exceeds prescribed range and computer generated alarm is displayed immediately disengage auto nav mode of airship nav system.

TASK NO.	P	CN	CM 1	CM 2	7:55	8:00	8:05	8:10	8:15		
2590	x								ONGOING		
2580	x	x							ONGOING		
2570	x	x							ONGOING		
2560	x	x							ONGOING		
2550	x	x							ONGOING		
2540	x	x							ONGOING		
2530	x										
2520	x										
2510		x									
2500	x										
2490	x										
2480	x										

P	2600	Monitor fuel status.
CN	2610	Guard int'l distress freq.
P	2620	Scan externally.
P	2630	Monitor tow line and tow on video display units.
P	2640	Monitor attitude, speed, and altitude.
P	2650	Monitor heading.
P	2660	Maintain flight conditions.
P/CN	2670	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
P/CN	2680	Monitor FLAR display.
CN	2690	Maintain comms with distressed vessel.
CN	2700	Navigate to rendezvous with surface towing vessel.
P	2710	Rendezvous with surface towing vessel.
END TOW		
HOVER		
P	2720	Station CM1 at towing winch.
P	2730	Configure airship winch to reel in tow line.
P	2740	Communicate with towing vessel and distressed vessel. Inform them tow will be suspended by airship and continued by towing vessel. Request towing vessel to remain clear until airship tow line is disengaged and recovered.

TASK NO.	P	CN	CM 1	CM 2	8:15	24:25	24:30	24:35	24:40	24:45
2740	x									
2730	x									
2720	x									
2710	x									
2700		x			ONGOING					
2690		x			ONGOING					
2680	x	x			ONGOING					
2670	x	x			ONGOING					
2660	x				ONGOING					
2650	x				ONGOING					
2640	x				ONGOING					
2630	x				ONGOING					
2620	x				ONGOING					
2610		x			ONGOING					
2600	x				ONGOING					

P	2750	Receive acknowledgment.
P	2760	Disengage auto nav mode of airship nav system. Disengage altitude hold. Shift from CRUISE to HOVER regime.
P	2770	Maintain 100 foot altitude and slow speed while tow line is shortened to approximately 600 feet out.
CM1	2780	Reel in tow line to approximately 600 feet.
P	2790	When approximately 600 feet of line remain hover in front of distressed vessel and allow line to slack to water.
P	2800	Comm by radio to distressed vessel and order tow line to be disengaged.
P	2810	Receive report tow line disengaged.
CM1	2820	Recover remainder of tow line.
P,CM1	2830	Hover over distressed vessel and recover airship rescue personnel and emergency equipment.
P	2840	When personnel and gear are on board, clear distressed vessel.
P	2850	Discharge ballast as necessary to compensate for weight of personnel and equipment brought back on board.
P/CN	2860	Acknowledge and take action on computer generated alarms and computer generated status reports.
P	2870	Monitor fuel status.
CN	2880	Guard int'l distress freq.
P	2890	Scan externally.

TASK NO.	P	CN	CM 1	CM 2	24:45 25:00 25:15 25:30 25:45 26:00
2890	x				ONGOING
2880		x			ONGOING
2870	x				ONGOING
2860	x	x			ONGOING
2850	x				ONGOING
2840	x				
2830	x		x		
2820			x		
2810	x				
2800	x				
2790	x				
2780			x		
2770	x				
2760	x				
2750	x				

P/CN	2900	Monitor FLAR display.
P	2910	Maintain flight conditions.
P	2920	Secure stern mounted TV camera.
P/CN	2930	Make situation report to SAR control center.
P/CN	2940	Receive acknowledgment.

END HOVER

END RENDERING ASSISTANCE AND TOWING A SMALL VESSEL IN DISTRESS

RECOVERY OF SURVIVORS IN THE WATER

In order to cover both possibilities (survivor able to enter basket by himself and survivor requires airship crew help to enter the basket), this scenario will describe the recovery of two survivors. The first to be recovered will be able to enter the basket unaided, the second will require assistance in entering the basket. The tasks involved are:

Crew-member	Task No.	Task Title
DESCEND TO 100 FEET		
P	2950	Request designated control agency clearance to descend to 100 feet.
P	2960	Receive clearance.
P	2970	Alert crew on ICS/PA that airship will descend.
P	2980	Rotate airship to optimum descent angle.

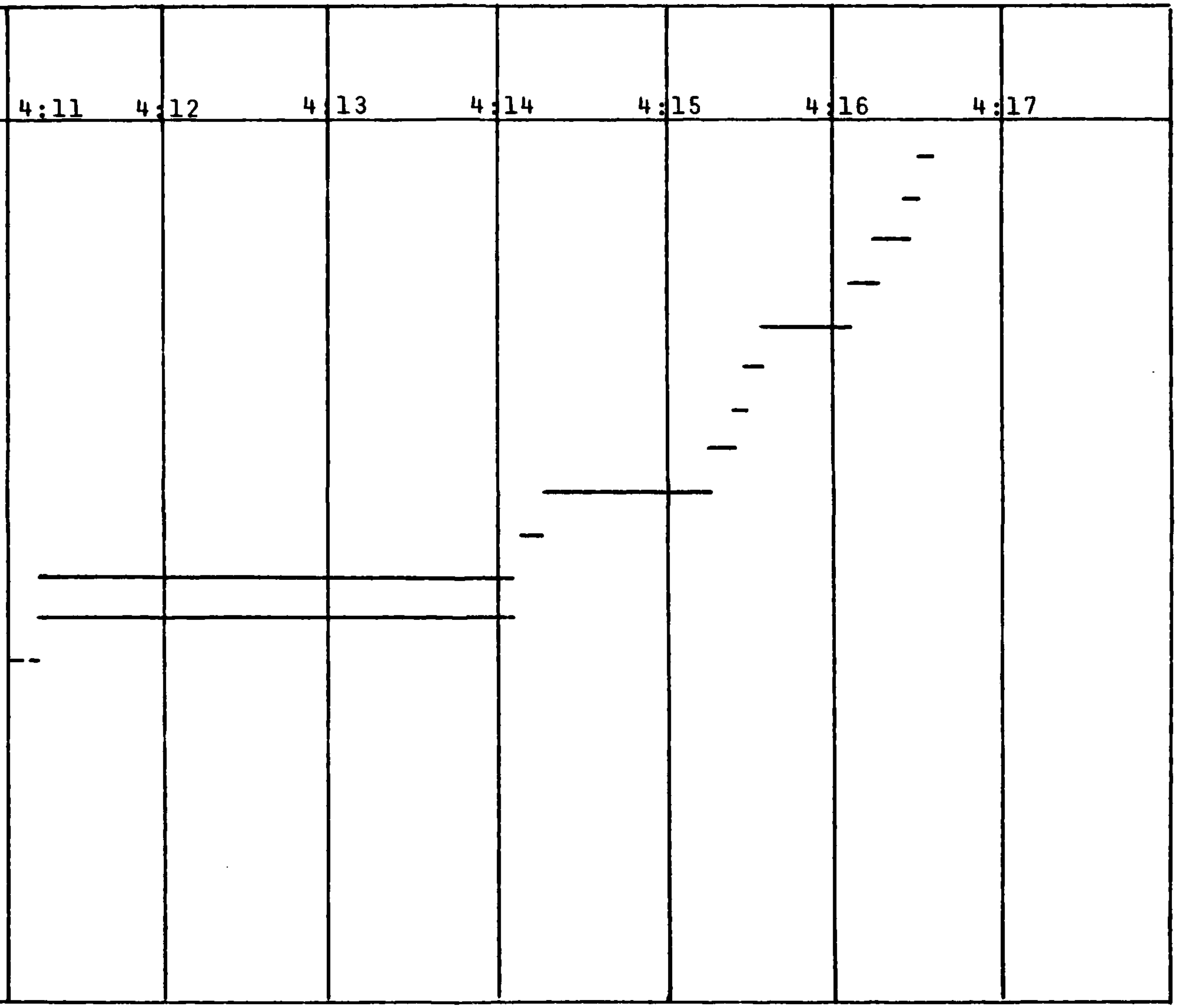
TASK NO.	P	CN	CM 1	CM 2	25:45 26:00 TIME CHANGE 4:00 4:01 4:02
2980	x				
2970	x				
2960	x				
2950	x				
2940	x	x			
2930	x	x			
2920	x				
2910	x				ONGOING
2900	x	x			ONGOING

P	2990	Commence leveling out when passing 2,000 feet (6 ship lengths).
P	3000	Reduce speed.
P	3010	Level out at 100 feet, slow to speed no greater than 35 kts.
P/CN	3020	Report altitude to designated control agency.
P/CN	3030	Receive acknowledgment.
P	3040	Approach survivors from downwind.
P	3050	Station CM1 at stern winch position.
P,CM1	3060	Check ICS comms between pilot and winch position.
P	3070	Slow airship to approximately 5 kts when 300 feet from survivors.
P/CN	3080	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
CN	3090	Guard int'l distress freq.
P	3100	Energize underside TV camera (located at rescue winch station).
P	3110	Select underside TV on P and CP TV monitors.
END DESCENT		
HOVER		
P	3120	Shift from CRUISE to HOVER regime.
P/CN	3130	Make situation report to SAR control.

TASK NO.	P	CN	CM 1	CM 2	4:01	4:03	4:05	4:07	4:09	4:11	
3130	x	x									
3120	x										
3110	x										
3100	x										
3090		x							ONGOING		
3080	x	x							ONGOING		
3070	x										
3060	x		x								
3050	x										
3040	x										
3030	x	x									
3020	x	x									
3010	x										
3000	x										
2990	x										
2980	x										

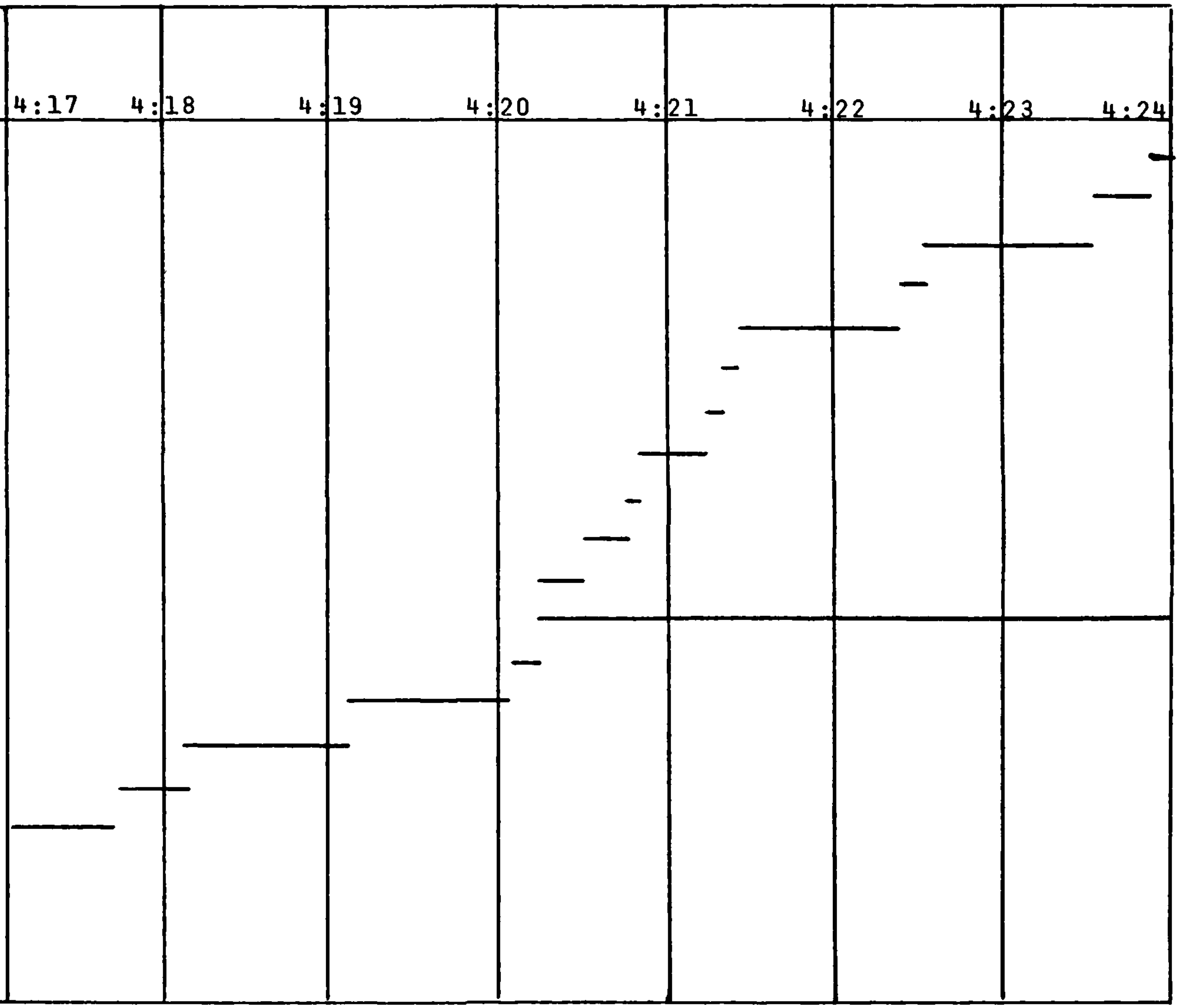
P/CN	3140	Receive acknowledgment.
P	3150	Remain at 100 foot altitude and slowly bring airship over survivors.
CM1	3160	CM1 assist pilot by giving conning directions via the ICS.
P	3170	P inform CM1 when survivor is in sight on video display unit.
P	3180	Commence descending airship while hovering over survivors. Bring airship to within 10 to 40 feet of the surface, depending on sea state.
CN	3190	Activate external loudspeakers.
CM1	3200	CM1 request survivors to raise arm if not injured (via PA and external speakers).
CM1	3210	CM1 inform pilot of status of survivors (injured or not injured).
P	3220	Position airship so rescue basket is directly over first survivor. Rescue crewman give pilot conning directions via ICS.
CM1	3230	CM1 reports ready with hoist and rescue basket.
P	3240	When airship in position with hoise directly over survivor hold airship in position.
P	3250	Verify electronic altimeter and doppler velocity radar altimeter operating correctly and outputs are being received by CPC.
P	3260	If desired, select PRIME/DISCONNECT mode of ship control (permits P to take hands off controls and airship

TASK NO.	P	CN	CM 1	CM 2
3260	x			
3250	x			
3240	x			
3230			x	
3220	x			
3210			x	
3200			x	
3190		x		
3180	x			
3170	x			
3160			x	
3150	x			
3140	x	x		



		inertial nav system will command the propulsion engines to maintain airship's position).
CM1	3270	Lower and guide rescue basket to survivor.
CM1	3280	Visually verify survivor securely in rescue basket.
CM1	3290	Hoist survivor up to airship. Inform pilot via ICS.
CM1	3300	Assist survivor into interior of airship.
CM1	3310	Inform P via ICS when survivor is inside airship.
CM1	3320	Render first aid to survivor if needed.
CM2	3330	CM2 enters rescue basket.
CM1	3340	Inform pilot via ICS that CM2 is ready to be lowered.
P	3350	Order via ICS that basket be lowered.
CM1	3360	CM1 acknowledges and lowers basket with CM2 into water.
CM1	3370	Report to P via ICS when basket is in water.
P	3380	Acknowledge.
CM2	3390	Grasp injured survivor and guide him into basket. Cradle survivor to prevent further injury.
CM2	3400	Signal airship when survivor in basket.
CM1	3410	Inform P survivor is in basket and commence hoisting survivor and rescue crewman.
CM1	3420	Assist CM2 and survivor to enter airship.
CM1	3430	Inform P via ICS that all are on board.

TASK NO.	P	CN	CM 1	CM 2
3430			x	
3420			x	
3410			x	
3400				x
3390				x
3380	x			
3370			x	
3360			x	
3350	x			
3340			x	
3330				x
3320			x	
3310			x	
3300			x	
3290			x	
3280			x	
3270			x	



P	3440	Acknowledge.
CM2	3450	Render first aid to survivor if needed.
P	3460	Remaining in HOVER regime bring airship up to 100 foot altitude.
P/CN	3470	Make situation report to SAR control.
P/CN	3480	Receive acknowledgment.
P	3490	Discharge ballast as necessary to compensate for weight of personnel brought on board.
CN	3500	Guard int'l distress freq.
P	3510	Monitor fuel status.
P/CN	3520	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
P	3530	Scan externally.
P	3540	Maintain flight conditions.
P	3550	Secure the underside TV camera.
CN	3560	Secure the external speakers.
P	3570	If it had been selected, shift out of PRIME/DISCONNECT mode of ship control.
P	3580	Shift from HOVER to CRUISE regime.

END HOVER

END RECOVERY OF SURVIVORS IN THE WATER

TASK NO.	P	CN	CM 1	CM 2	4:24	4:25	4:26	4:27	4:30	4:31	4:35	4:39
3580	x											
3570	x											
3560		x										
3550	x											
3540	x								ONGOING			
3530	x								ONGOING			
3520	x	x							ONGOING			
3510	x								ONGOING			
3500		x							ONGOING			
3490	x											
3480	x	x										
3470	x	x										
3460	x											
3450				x								
3440	x											
3320			x									

CLIMB TO CRUISE ALTITUDE

After recovery of the tow line (rendering assistance to a distressed vessel) or recovery of survivors, the airship climbs to cruise altitude in preparation for return to base. The tasks involved are:

Crew-member	Task No.	Task Title
P/CN	3590	Request designated control agency clearance to climb to 5,000 feet.
P/CN	3600	Receive clearance.
P	3610	Alert crew on ICS/PA that airship will climb.
P	3620	Rotate airship sufficiently to commence climb but exercise caution not to allow stern of airship to approach ocean surface closer than 75 feet.
P	3630	When clear of the ocean surface increase rotation to optimum ascent angle.
P	3640	Increase speed to 50 kts.
CN	3650	Enter present posit (lat/long) and posit of intended landing field (lat/long) in CPC via the CDP.
P	3660	Read heading to steer for intended landing field from CPC. Maintain the heading.
P	3670	Level out at 5,000 feet, maintain speed of 50 kts.
P/CN	3680	Report altitude to designated control agency.
P/CN	3690	Receive acknowledgment.

TASK NO.	P	CN	CM 1	CM 2	4:31	4:32	4:33	4:34	4:35	4:36	4:39	4:41
3690	x	x										
3680	x	x										
3670	x											
3660	x											
3650		x										
3640	x											
3630	x											
3620	x											
3610	x											
3600	x	x										
3590	x	x										

P/CN	3700	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
CN	3710	Guard int'l distress freq.
P	3720	Monitor fuel status.
P	3730	Scan externally.
P	3740	Maintain flight conditions.

END CLIMB TO CRUISE ALTITUDE

END SEGMENT 3 - ON STATION OPERATIONS

SEGMENT 4 - CRUISE BACK

The airship cruises at 5,000 feet at 50 kts to the air field approach point designated for commencement of descent in preparation for landing. The tasks involved are:

Crew-member	Task No.	Task Title
CN	3750	Order nav system to display course to steer to reach landing field.
P	3760	Read desired heading from computer control and display panel (CDP).
P/CN	3770	Request designated control agency clearance to proceed on desired heading at speed of 50 kts, altitude of 5,000 feet.
P/CN	3780	Receive clearance.
P	3790	Verify electronic altimeter and doppler velocity radar altimeter operating correctly and outputs are being received by CPC.

TASK NO.	P	CN	CM 1	CM 2	4:40 4:41 4:42
3790	x				
3780	x	x			
3770	x	x			
3760	x				
3750		x			
3740	x				ONGOING
3730	x				ONGOING
3720	x				ONGOING
3710		x			ONGOING
3700	x	x			ONGOING

P	3800	Set altitude desired (5,000 feet) into CPC via the CDP.
P	3810	Ensure actual altitude is 5,000 feet ± 100 feet.
P	3820	Engage altitude hold.
CN	3830	Order airship nav system to proceed to desired landing field posit at 50 kts speed.
P/CN	3840	Make situation report to SAR center.
P/CN	3850	Receive acknowledgment.
CN	3860	Change communication frequencies as directed.
CN	3870	Change nav freq as necessary.
CN	3880	Change IFF codes as directed.
CN	3890	Note posit report/time to go advisory messages from AS nav system.
P/CN	3900	Comm report to designated control agency for course changes.
P/CN	3910	Receive acknowledgment.
CN	3920	Guard int'l distress freq.
P/CN	3930	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
P	3940	Monitor fuel status.
P	3950	Scan externally.
P	3960	Monitor attitude, speed and altitude.

TASK NO.	P	CN	CM 1	CM 2	4:42 4:43 4:44 4:45 5:00 5:30 6:00
3960	x				ONGOING
3950	x				ONGOING
3940	x				ONGOING
3930	x	x			ONGOING
3920		x			ONGOING
3910	x	x			ONGOING
3900	x	x			ONGOING
3890		x			ONGOING
3880		x			ONGOING
3870		x			ONGOING
3860		x			ONGOING
3850	x	x			
3840	x	x			
3830		x			
3820	x				
3810	x				
3800	x				
3790	x				

P	3970	Monitor heading.
P	3980	Maintain flight conditions.
P/CN	3990	Monitor FLAR display.
P/CN	4000	When at designated distance from field for shift from designated agency control to approach control (nominally 10 nm.) receive clearance/freq from control ctr to contact approach control.
P/CN	4010	Select approach freq and get radio contact with approach control (Note: CN requests weather, altimeter setting, landing runway and clearance for approach).
P/CN	4020	Receive, record clearance; insure P understands clearance.

END SEGMENT 4 - CRUISE BACK

SEGMENT 5 - LAND

The airship descends from 5,000 feet during approach to the field and lands neutrally buoyant in the HOVER regime. Extremely slow speed approaches and vertical landing with zero forward velocity are possible if mandated by weather conditions at the landing field. After landing the airship will taxi to its mast and be attached to the mast. After attachment to the mast the stern of the airship will be attached to the ground securing system. The airship will be powered down and postflight checks conducted. The tasks involved are:

TASK NO.	P	CN	CM 1	CM 2	6:00	6:10	6:20	6:30			
4020	x	x									
4010	x	x									
4000	x	x									
3990	x	x					ONGOING				
3980	x					ONGOING					
3970	x				ONGOING						

Crew-member	Task No.	Task Title
DESCEND/LAND		
CN	4030	Receive clearance, record all clearances and instructions insure pilot understands all clearances and instructions.
CN	4040	Alert crew on ICS/PA that airship will descend.
CN	4050	Receive verification crew alerted.
CN	4060	Inform P "Crew Alerted."
P	4070	Verify RAWS (APQ-107 or equivalent) operating correctly. Set desired altitude in RAWS.
P	4080	Start APU.
P	4090	Bring airship to desired descent attitude.
P/CN	4100	Monitor FLAR display.
P	4110	Maintain flight conditions.
P	4120	Monitor rate of descent.
P	4130	Maneuver AS as required to conform to clearance (continuous control).
P	4140	Energize landing lights.
P/CN	4150	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
P	4160	Monitor fuel status.
P	4170	Scan externally.

TASK NO.	P	CN	CM 1	CM 2	6:30	6:31	6:32	6:33	6:34		
4170	x							ONGOING			
4160	x							ONGOING			
4150	x	x						ONGOING			
4140	x										
4130	x						ONGOING				
4120	x						ONGOING				
4110	x						ONGOING				
4100	x	x					ONGOING				
4090	x										
4080	x										
4070	x										
4060		x									
4050		x									
4040		x									
4030		x									

CN	4180	Receive lost comm procedures.
CN	4190	Record lost comm procedures.
CN	4200	Acknowledge lost comm procedures.
CN	4210	Insure P understands lost comm procedures.
P	4220	Rec heading changes from GCA.
P	4230	Rect inst to turn on "base leg" from GCA
CN	4240	Receive/ack/record missed approach proc from GCA & insure P understands.
P	4250	Rec inst to final approach course GCA.
P,CN	4260	Check safety harnesses secured.
P	4270	Notified by GCA that glide path is being intercepted.
P	4280	Adjust power to EST pre-determined rate of descent.
P	4290	Scan externally.
P	4300	Maintain constant A/S and AOA throughout approach by adjusting AS pitch angle. (When the deisred A/S, glide path and R/D are being maintained note the PWR, altitude & vert speed as a guide for the remainder of the approach).
P	4310	Inform approach control when visual contact with field achieved.
P	4320	Conduct comm check with tower.
P	4330	Request approach control for handoff to tower.
P	4340	Acknowledge handoff to tower.

TASK NO.	P	CN	CM 1	CM 2	6:35		6:40	6:45	6:46	6:47	6:48
4340	x										
4330	x										
4320	x										
4310	x										
4300	x								ONGOING		
4290	x								ONGOING		
4280	x										
4270	x										
4260	x	x									
4250	x										
4240		x									
4230	x										
4220	x				ONGOING						
4210		x									
4200		x									
4190		x									
4180		x									

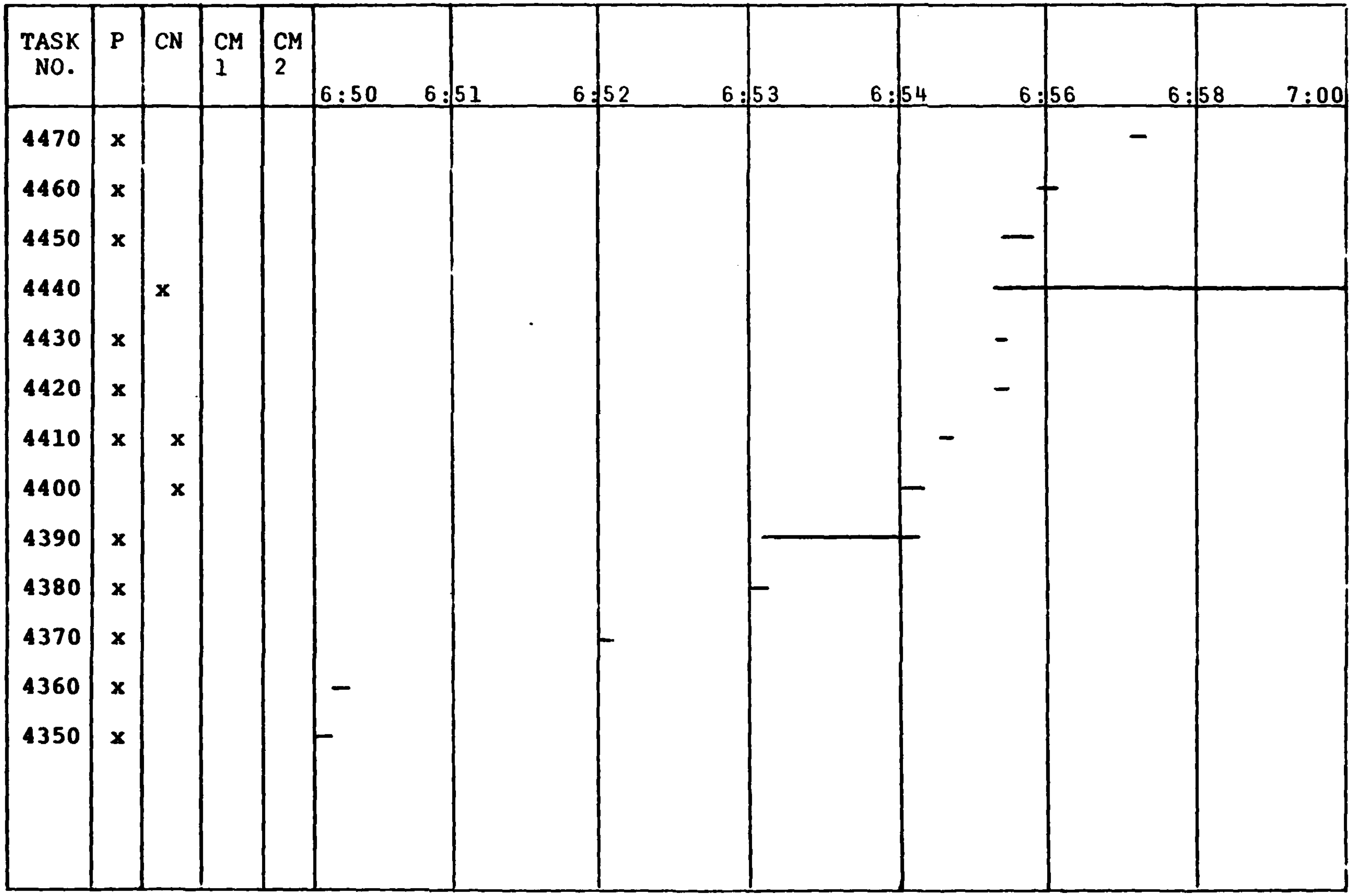
P	4350	When at 200 foot altitude or at 2 miles from field shift from CRUISE to HOVER regime.
P	4360	Point bow of AS at point of intended landing.
P	4370	Slow to 10 kts when at end of runway.
P	4380	Slow to 5 kts when within 200 feet of intended landing spot.
P	4390	Use down thrust to land on intended spot with no more than 2 kts forward velocity.

END DESCEND/LAND

TAXI

CN	4400	Contact ground control on published freq for taxi inst and close out flight plan
P/CN	4410	Rec taxi inst.
P	4420	Taxi AS per inst.
P	4430	Control AS using HOVER regime commands on hand controllers. Maintain slight down thrust.
CN	4440	Conduct "after landing" checklist.
P	4450	Rec visual inst from lineman for approach to mast.
P	4460	Check for clear sides.
P	4470	Rec inst from lineman to stop AS when within 100 feet of mast.

END TAXI


TASK NO.
P
CN
CM 1
CM 2
6:50
6:51
6:52
6:53
6:54
6:56
6:58
7:00
4470
4460
4450
4440
4430
4420
4410
4400
4390
4380
4370
4360
4350
x

CONNECT TO MAST

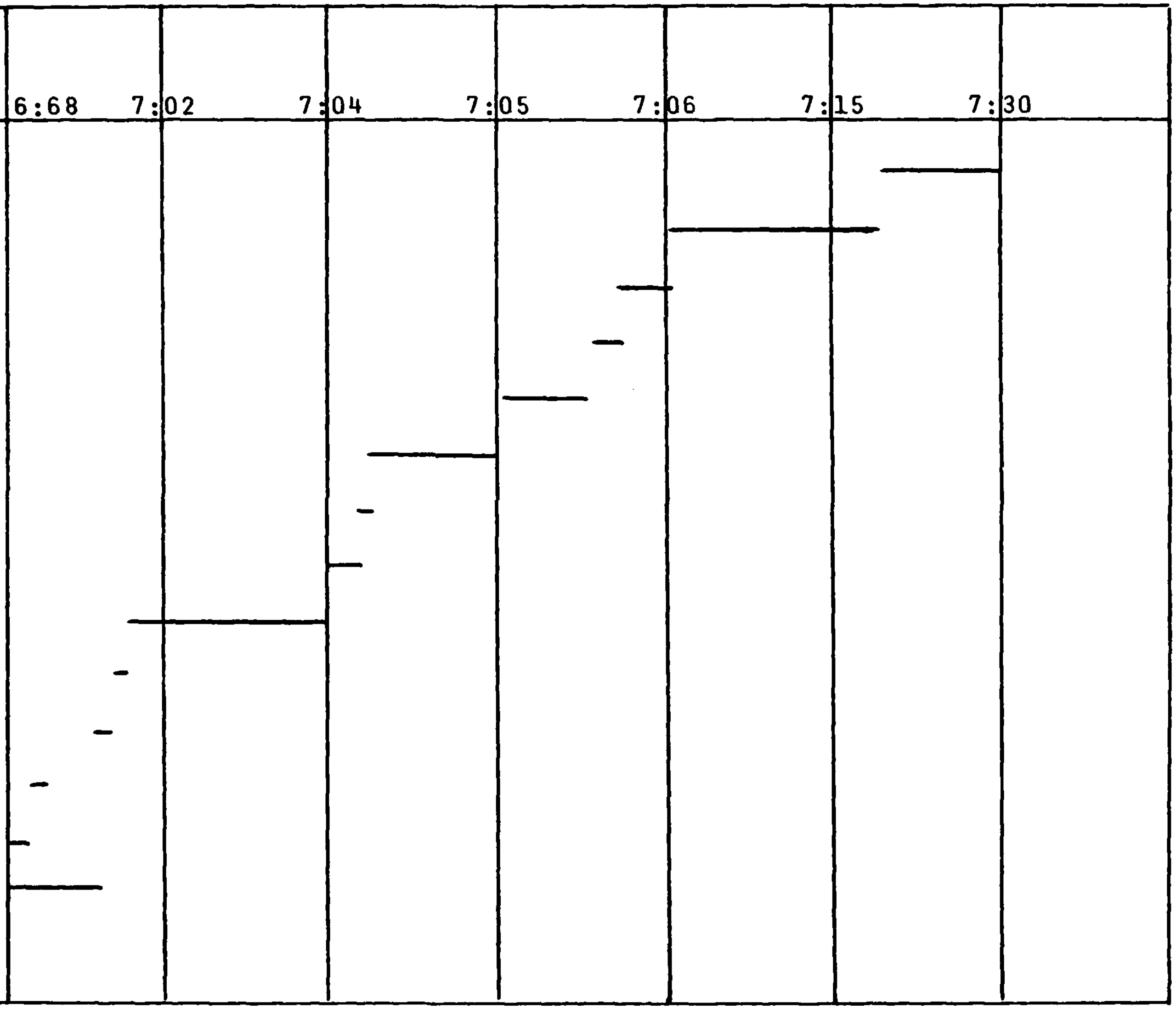
		NOTE: LINEMAN CONNECTS EXTERNAL PHONE CABLE TO EXTERNALLY MOUNTED ICS JACK.
P	4480	Conduct comm check with lineman.
P	4490	Order lineman to connect AS bow to mast.
P	4500	Receive report AS bow secured to mast.
P	4510	Order linehandlers to disembark and attach stern line to ground securing system.
CM1,CM2	4520	Linehandlers disembark and attach stern line to ground securing system.
P	4530	Rec report from lineman that stern is secured.
P	4540	Release down thrust command on left handcontroller.

END CONNECT TO MAST

POWER DOWN

P	4550	Shut down main engines.
P	4560	Turn off hydraulic power units (HPUs).
P	4570	Turn off landing lights.
P	4580	Secure APU.
P,CN	4590	Complete after landing checklist.
CN	4600	Fill out "yellow sheet" (times, malfunctions, discrepancies).

TASK NO.	P	CN	CM 1	CM 2
4600		x		
4590	x	x		
4580	x			
4570	x			
4560	x			
4550	x			
4540	x			
4530	x			
4520			x	x
4510	x			
4500	x			
4490	x			
4480	x			
4440		x		



P	4610	Sign "yellow sheet," turn it over to maintenance organization.
ALL	4620	Crew debrief with appropriate control agency.
CN,CM1	4630	Return necessary equipment.

END POWER DOWN

END SEGMENT 5 - LAND

TASK NO.	P	CN	CM 1	CM 2	7:30	8:00	8:30				
4630		x	x								
4620	x	x	x	x							
4610	x										

APPENDIX B - TASK ANALYSIS FOR ASW ON STATION OPERATIONS

A. FORMAT OF THE TASK ANALYSIS

1. Crewmember positions always appear first in each task descriptive statement. These are abbreviated as:

P = pilot

CN = communicator/navigator

SS1 = sensor station 1 operator

CK = cook.

2. If several (but not all) crewmembers are to perform a given task, then the letters indicating which are separated by a comma, as:

P,CN 0050 Monitor ASW tactical net.

If one <u>or</u> the other (but not necessarily both) are to perform a given item, then:

P/CN 0060 Monitor BTR.

SEGMENT 3 - ON STATION OPERATIONS

RENDEZVOUS

Upon reaching the rendezvous point the airship reports to the ASW Screen Commander and descends to 1,000 feet. The Screen Commander assigns the initial screen station to the airship and promulgates the EMCON (electronic emission control) condition. The tasks involved are:

Crew-member	Task No.	Task Title
P	0010	Report via voice radio circuit to SCRN CDR (screen commander) providing normal information for unit joining task group.

P	0020	Receive ASAC control assignment from SCRN CDR.
P	0030	Shift to ASAC frequency and establish comms.
P	0040	Inform ASAC that airship is descending to 1,000 feet.
P	0050	Receive acknowledgment.
P	0060	Alert crew on ICS/PA that airship will descend.
P	0070	Position airship to optimum descent angle.
P	0080	Commence leveling out when passing 3,000 feet (6 ship lengths).
P	0090	Commence reducing speed.
P	0100	Level out at 1,000 feet. Slow to match speed of surface vessels.
P/CN	0110	Receive initial ASW screen assignment and EMCON condition from ASAC.
P/CN	0120	Acknowledge ASAC orders.
P,CN	0130	Set ordered EMCON condition. Secure electronic emitters as required.
P	0140	Verify ESM equipment is operating.
CN	0150	Station SS1.
SS1	0160	Take station.
P,CN,SS1	0170	Test ICS comms.
P/CN	0180	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
P/CN	0190	Monitor fuel status.
P	0200	Scan externally.
P	0210	Maintain flight conditions.

END RENDEZVOUS

TAKE STATION

The airship proceeds to initial ASW station at stationing speed of 90 kts. The tasks involved are:

Crew-member	Task No.	Task Title
CN	0220	Set surface group's base course and base speed into CPC via CDP.
CN	0230	Set range and bearing of ordered screen station from surface ships into CPC via CDP.
CN	0240	Set speed to take station (90 kts) into CPC via CDP.
P/CN	0250	Read course to steer to reach station from CPC on CDP.
P	0260	Set course to steer and 90 kts speed into CPC via CDP.
P	0270	Verify electronic altimeter and doppler velocity radar altimeters operating correctly and outputs are being received by CPC.
P	0280	Set altitude desired (1,000 feet) into CPC via the CDP.
P	0290	Ensure actual altitude is 1,000 ± 50 feet.
P	0300	Verify in CRUISE regime.
P	0310	Enable autopilot.
P	0320	Engage altitude hold.
CN	0330	Monitor airship progress on NAV DATA plotter.
P/CN	0340	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
P/CN	0350	Monitor fuel status.
P	0360	Scan externally.

P,CN	0370	Monitor ASW tactical net.
P	0380	Monitor heading, attitude, speed, and altitude.
SS1	0390	Power up and test IAIRTASS avionics.
CN	0400	Inform P when NAV DATA plotter indicates airship on station.
P	0410	If EMCON condition permits, radiate APS-127 FLAR for two sweeps to verify on station.
P	0420	If EMCON condition permits, report on station to ASAC.
P	0430	Receive acknowledgment.

END TAKE STATION

DEPLOY ARRAY

The airship obtains a sound velocity profile of acoustical conditions, deploys the IAIRTASS array, and commences a slow speed tow of the array. The airship maintains only enough speed to keep the array at the desired tactical depth for optimum detection probability. The tasks involved are:

Crew-member	Task No.	Task Title
P	0440	Disengage autopilot and altitude hold.
P	0450	Maneuver airship to remain on station while slowing from 90 kts airspeed.
P	0460	Commence descent while speed is reduced.
P	0470	When speed is decreased to 10 kts or less shift from CRUISE to HOVER retime.
P	0480	Thrust down and continue descent to 40 feet.
P	0490	Hover at 40 feet.
P	0500	Set altitude desired (40 feet) into CPC via CDP.

P	0510	Engage altitude hold.
P	0520	Order SS1 to drop a BT device, to commence deploying the array, and to lower the ballasting hose.
SS1	0530	Acknowledge.
SS1	0540	Load BT device into chute.
SS1	0550	Drop BT device.
SS1	0560	Monitor BT receiver for returns as device deploys.
SS1	0570	Lower ballasting hose.
SS1	0580	Verify hydraulic power available at winch.
SS1	0590	Actuate "array lower" switch on avionics console and move winch control level forward.
P,SS1	0600	Monitor cable tension indicators.
SS1	0610	Report sound velocity profile as indicated on BT receiver to P and recommend array deployment depth to P based on tactical doctrine.
P	0620	Acknowledge report.
P	0630	Order deployment depth.
SS1	0640	Acknowledge.
SS1	0650	Monitor cable footage indicator.
SS1	0660	When amount of cable is deployed as required for ordered array depth return winch control lever to neutral position. Deactivate "array lower" switch.
P	0670	Operate Transfer Ballast Control Panel to take on sea water ballast to compensate for TASS array.
SS1	0680	Report to P that array is deployed.
P	0690	Acknowledge.
P	0700	Order SS1 to recover ballast hose.

SS1	0710	Acknowledge.
SS1	0720	Recover ballast hose.
SS1	0730	Report to P that ballast hose recovered.
P	0740	Acknowledge.
P	0750	Disengage altitude hold.
P	0760	Thrust up and increase altitude to 100 feet.
P	0770	When at 100 feet slowly build up airship's speed to amount required to achieve desired array depth.
P	0780	Steer best course to suit sea/air conditions and remain on station. NOTE: ARRAY DEPTH IS A FUNCTION OF AMOUNT OF CABLE DEPLOYED AND AIRSHIP SPEED.
P,SS1	0790	Monitor array speed and depth on Environmental Display Panel.
P	0800	When array is at desired tactical depth shift from HOVER to CRUISE regime.
P	0810	Adjust speed as necessary to achieve stabilization of array at desired tactical depth.
P	0820	When array is stabilized at desired tactical depth, set course and speed, which were required to stabilize the array, into CPC via CDP.
P	0830	Set altitude desired (100 feet) into CPC via CDP.
P	0840	Engage autopilot and altitude hold.
P/CN,SS1	0850	Monitor BTR.
P/SS1	0860	Monitor array speed and depth on Environmental Display Panel.
P/CN	0870	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
P	0880	Monitor fuel status.

P	0890	Scan externally.
P/CN	0900	Monitor ASW tactical net.
P	0910	Monitor attitude, speed, heading, and altitude.

END DEPLOY ARRAY

SEARCH/CLASSIFY CONTACTS

The airship remains on station for approximately 2.5 hours while maintaining a passive acoustic watch. Contacts which are detected are classified and appropriate reports made. The surface group overtakes the airship on station and passes on ahead. When the surface group has moved approximately 8 nautical miles beyond the airship, the sonar array is recovered. The tasks involved are:

Crew-member	Task No.	Task Title
P/CN,SS1	0920	Monitor the BTR for target-of-interest indications. NOTE: THE PRESENCE AND BEARING OF A TARGET IS INDICATED BY VERTICAL LINES PRINTED ON ELECTRO-SENSITIVE PAPER IN THE BEARING TIME RECORDER.
SS1	0930	When an acoustical contact is detected on the BTR read the two possible bearings of the contact off the optical cursor on the BTR.
SS1	0940	Inform the P of contact detection and possible bearings.
P	0950	Acknowledge.
P	0960	Disengage autopilot and altitude hold.
P	0970	Maneuver airship 90 degrees to port or to starboard.

SS1	0980	Observe BTR and determine actual contact bearing as airship turns.
SS1	0990	Report actual contact bearing to P.
P	1000	Acknowledge.
SS1	1010	Select spread of four beams on WAP-2 to encompass the actual bearing of the target plus adjacent beams.
SS1	1020	Classify target from WAP-2.
SS1	1030	Report target classification to P.
P	1040	Acknowledge.
P/CN	1050	If target is classified as submarine, make report to ASAC.
P/CN	1060	Receive acknowledgment.
P	1070	Set course and speed into CPC via CDP required to maintain array at desired tactical depth.
P	1080	Set altitude desired (100 feet) into CPC via CDP.
P	1090	Engage autopilot and altitude hold.
SS1	1100	Track target on BTR.
P/CN	1110	Report target bearing to ASAC at intervals prescribed by tactical doctrine.
P/CN	1120	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
P	1130	Monitor fuel status.
P	1140	Scan externally.
P/CN	1150	Monitor ASW tactical net.
P	1160	Monitor attitude, speed, heading, and altitude.

END SEARCH/CLASSIFY CONTACTS

RECOVER ARRAY

The airship remains on station for approximately 2.5 hours maintaining a passive acoustic watch while the surface group overtakes the airship and moves ahead. If directed by the ASAC to prosecute a target the array is immediately recovered. Otherwise the array is recovered when the surface group is approximately 8 nautical miles beyond the airship. The tasks involved are:

Crew-member	Task No.	Task Title
P	1170	Disengage autopilot and altitude hold.
P	1180	Shift from CRUISE to HOVER regime.
P	1190	Thrust down and hover at 40 feet.
P	1200	Order SS1 to recover the array.
CM1	1210	Acknowledge.
CM1	1220	Verify hydraulic power available at winch.
CM1	1230	Actuate "raise" switch on 1AIRTASS avionics console and move winch control level back.
P,SS1	1240	Monitor cable tension indicators.
		NOTE: RETRIEVAL TAKES ABOUT 23 MINUTES.
P	1250	Set altitude desired (40 feet) into CPC via CDP.
P	1260	Discharge water ballast to compensate for weight of array being recovered.
P	1270	Enable altitude hold.
SS1	1280	Monitor Cable Footage Indicator.
SS1	1290	When 15 feet of array remain to be winched in, inform pilot, and utilize override switch to expedite recovery.

NOTE: FINAL 15 FEET OF ARRAY AUTOMATICALLY REWOUND AT VERY SLOW SPEED UNLESS MANUALLY OVERRIDEN.

P	1300	Acknowledge.
P	1310	Disengage altitude hold.
P	1320	Thrust up to 100 feet.
P	1330	When at 100 feet, shift from HOVER to CRUISE regime.
SS1	1340	Power down 1AIRTASS equipment.
SS1	1350	Report 1AIRTASS array recovered and avionics powered down.
P	1360	Acknowledge.

END RECOVER ARRAY

LOCALIZE WITH MAD

At the discretion of the Screen Commander the airship can be utilized to prosecute a target. Under the control of the ASW air control ship designated by the Screen Commander the airship is vectored to the submarine target's position. The airship uses MAD gear to localize the target. The tasks involved are:

Crew-member	Task No.	Task Title
CN	1370	Energize MAD gear.
CN	1380	Report MAD gear energized to P.
P	1390	Acknowledge.
P	1400	Receive course to steer to submarine's position from ASAC.
P	1410	Acknowledge.

P	1420	Bring airship to ordered course and increase speed to 90 kts.
P	1430	Report heading, speed, and altitude to ASAC.
P	1440	Request ASAC permission to radiate FLAR.
P/CN	1450	Receive permission.
CN	1460	Radiate FLAR.
P	1470	Inform ASAC increasing altitude to deploy MAD bird.
P	1480	Receive acknowledgment.
P	1490	Increase altitude to 400 feet.
P	1500	When at 400 feet, order MAD towed body deployed.
CN	1510	Acknowledge.
CN	1520	Deploy MAD towed body.
CN	1530	Energize stern zoom TV camera and TV monitor.
CN	1540	Verify MAD towed body deployed.
CN	1550	Inform P MAD towed body deployed.
CN	1560	Monitor MAD gear.
P	1570	Acknowledge.
P	1580	Order SS1 to load marker device in chute.
		NOTE: SMOKE USED DURING DAY, FLARE AT NIGHT.
SS1	1590	Load marker device in chute.
SS1	1600	Report chute loaded.
P	1610	Acknowledge.
P	1620	Receive report "On top" from ASAC when airship passes over submarine position.
P	1630	Drop marker device by actuating switch on Transponder Release Panel.

P	1640	Maneuver airship to conduct tactical search in accordance with doctrine.
P	1650	Order SS1 to load marker device in chute.
SS1	1660	Acknowledge.
SS1	1670	Load marker device.
SS1	1680	Report chute loaded.
P	1690	Acknowledge.
CN	1700	Report "madman" to P when target detected on MAD gear.
P	1710	Report "madman" to ASAC and drop marker device.
P	1720	Acknowledge report from CN.
P	1730	Receive acknowledgment from ASAC.
		NOTE: STEPS 1640 TRHOUGH 1730 ARE REPEATED AS OFTEN AS NECESSARY TO MAINTAIN CONTACT ON THE SUBMARINE.

END LOCALIZE WITH MAD

ATTACK

Authorization to attack the submarine target is given the airship by the ASAC. The airship conducts MAD runs on the target until attack criteria (which are classified and will not be discussed here) are fulfilled. The airship then conducts the attack by dropping acoustic homing torpedoes in the near vicinity of the target. The tasks involved are:

Crew-member	Task No.	Task Title
P	1740	Receive authorization from ASAC to attack upon fulfillment of attack criteria.

P	1750	Acknowledge.
P	1760	Set torpeo run parameters into torpedoes in accordance with tactical doctrine via Torpedo Firing Panel.
		NOTE: STEPS 1640 THROUGH 1730 ARE REPEATED UNTIL ATTACK CRITERIA ARE ACHIEVED.
P	1770	Maneuver airship to return down track of submarine.
P	1780	Release first torpedo by operating Torpedo Firing Panel in accordance with tactical doctrine.
P	1790	Release second torpedo by operating Torpedo Firing Panel in accordance with tactical doctrine.
P	1800	Report attack to ASAC.
P	1810	Receive acknowledgment.
P	1820	Maneuver airship to remain in immediate vicinity and observe for signs of underwater explosion.
		NOTE: TORPEDO WARHEAD DETONATION OCCURS ONLY IF ATTACK IS SUCCESSFUL. IF NO UNDERWATER EXPLOSION IS OBSERVED, STEPS 1760 THROUGH 1820 WOULD BE REPEATED.
P	1830	Report attack results to ASAC.
P	1840	Receive acknowledgment.
CN	1850	Recover MAD towed body.
CN	1860	Deenergize stern zoom TV camera and TV monitor.
CN	1870	Inform P MAD towed body is recovered.
P	1880	Acknowledge.

END ATTACK

PROCEED TO AIFR SHIP

(Although refueling would not be required yet,

it is included here for purposes of task analysis.)

The airship climbs to 1,000 feet and proceeds to the designated replenishment ship. The tasks involved are:

Crew-member	Task No.	Task Title
P	1890	Receive direction from ASAC to climb to 1,000 feet and come to designated vector to close replenishment ship at 45 kts.
P	1900	Acknowledge.
P	1910	Come to designated vector and slow to 45 kts.
P	1920	Position airship to climb to 1,000 feet.
P	1930	Level off at 1,000 feet.
P	1940	Report course, speed, and altitude to ASAC.
P	1950	Receive acknowledgment.
P	1960	Order SS1 and cook to prepare for replenishment.
CM1,CK	1970	Acknowledge.
P	1980	Inform ASAC when replenishment ship in sight.
P	1990	Receive acknowledgment.
P	2000	Req permission of ASAC to shift to replenishment ship controller.
P	2010	Receive permission.

COMPLETE PROCEED TO AIFR SHIP

AIFR AND REPLENISH

Crew-member	Task No.	Task Title
P	2020	Establish comms with replenishment ship controller on designated land/launch frequency.
P	2030	Req permission of replenishment ship to hover astern until replenishment ship ready to commence AIFR.
P	2040	Receive permission.

P	2050	Slow to match speed of replenishment ship and maneuver to take station 1,000 yards astern.
P	2060	Energize rescue hatch zoom TV camera and TV monitor.
P	2070	Shift from CRUISE to HOVER regime.
P	2080	Verify SS1 ready at winch to commence refueling.
P	2090	Receive permission from replenishment ship controller to commence approach.
P	2100	Acknowledge.
P	2110	Order SS1 to open hatch.
SS1	2120	Acknowledge.
CN	2130	Inform crew on ICS/PA that refueling is about to commence and secure the smoking lamp.
SS1	2140	Open hatch.
P	2150	Approach replenishment ship and decrease altitude to 100 feet.
P	2160	When over fantail of surface ship follow signals of LSE and hover.
P	2170	When in stable hover, order SS1 to lower cable and hook.
SS1	2180	Acknowledge.
SS1	2190	Report to P when hook is attached to fueling hose.
SS1	2200	Winch the fueling hose up into the airship.
SS1	2210	Report when fueling hose on board to P.
P	2220	Acknowledge.
SS1	2230	Take fuel sample from hose and send sample bottle forward with cook.
CK	2240	Show fuel sample bottle to pilot.
P	2250	If fuel sample is acceptable, order SS1 to connect fuel hose to fueling connection.

SS1	2260	Acknowledge.
SS1	2270	Connect fuel hose to quick disconnect fueling connection.
P	2280	Verify fueling system lined up to refuel.
P	2290	Order SS1 to open fueling stop valve.
SS1	2300	Acknowledge.
SS1	2310	Open fueling stop valve.
SS1	2320	Report valve open.
P	2330	Acknowledge.
P	2340	Inform replenishment ship controller ready to commence fueling.
P	2350	Receive acknowledgment.
P	2360	Follow signals of LSE to translate laterally outboard of replenishment ship.
P	2370	Maneuver outboard of replenishment ship until clear of fantail.
P	2380	Monitor fuel tanks.
P	2390	Discharge water ballast to compensate for fuel being taken on board.
P	2400	Give replenishment ship controller 3 minute standby when nearly completed refueling.
P	2410	Receive acknowledgment.
P	2420	When fuel tanks at designated fueling capacity, request replenishment ship controller to secure pumping.
P	2430	Receive acknowledgment.
P	2440	Order SS1 to shut fueling stop valve and to break quick disconnect fitting.
SS1	2450	Acknowledge.
SS1	2460	Shut fueling stop valve and break quick disconnect fitting.

P	2470	Follow signals of LSE and translate back over fantail.
P	2480	When LSE gives hover signal order SS1 to lower fueling hose.
SS1	2490	Acknowledge.
SS1	2500	Lower hose.
SS1	2510	When hose is disconnected by replenishment ship and stores container is connected to hook, winch the stores container up into the airship.
SS1	2520	Report to P when container on board.
P	2530	Acknowledge.
SS1,CK	2540	Unload BT devices and/or stores from stores container.
CK	2550	Stow BT devices and/or stores.
SS1	2560	Lower hook and container.
		REPEAT STEPS 2510 THROUGH 2560 AS REQUIRED.
SS1	2570	Lower hook and container final time.
SS1	2580	When replenishment ship crew has removed container, winch cable and hook back on board.
SS1	2590	Secure hatch.
SS1	2600	Inform pilot winch and hatch are secured.
P	2610	Acknowledge.
P	2620	Follow signals of LSE to move clear of replenishment ship.
P	2630	When clear of replenishment ship req. permission of replenishment ship controller to secure land/launch frequency.
P	2640	Receive permission.
P	2650	Reestablish comms with ASAC
P	2660	Shift from HOVER to CRUISE regime.

P	2670	Increase speed to 45 kts.
P	2680	Climb to 1,000 feet.
P	2690	Level off at 1,000 feet.

COMPLETE AIFR AND REPLENISH

RETURN TO STATION

P	2700	Report AIFR and replenishment completed to ASAC. Request duty assignment.
P	2710	Receive screen station assignment.
P	2720	Acknowledge.
CN	2730	Set surface group's base course and base speed into CPC via CDP.
CN	2740	Set range and bearing of ordered screen station from surface group into CPC via CDP.
CN	2750	Set stationing speed (90 kts) into CPC via CDP.
P/CN	2760	Read course to steer to reach station from CPC on CDP.
P	2770	Set course to steer and 90 kts. speed into CPC via CDP.
P	2780	Verify electronic altimeter and doppler velocity radar altimeters operating correctly and outputs are being received by CPC.
P	2790	Set altitude desired (1,000 feet) into CPC via the CDP.
P	2800	Ensure actual altitude is 1,000 feet ± 50 feet.
P	2810	Verify in CRUISE regime.
P	2820	Enable autopilot.
P	2830	Engage altitude hold.
CN	2840	Monitor airship progress on NAV DATA plotter.

P/CN	2850	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
P/CN	2860	Monitor fuel status.
P	2870	Scan externally.
P,CN	2880	Monitor ASW tactical net.
P	2890	Monitor heading, attitude, speed, and altitude.
SS1	2900	Power up and test 1AIRTASS avionics.
CN	2910	Inform P when NAV DATA plotter indicates airship on station.
P	2920	If EMCON condition permits, radiate APS-127 FLAR for two sweeps to verify on station.
P	2930	If EMCON condition permits, report on station to SCRN CDR.
P	2940	Receive acknowledgment.

END RETURN TO STATION

NOTE: THE SAME ASW OPERATIONS CONTINUE UNTIL THE COMPLETION OF THE OCEAN TRANSIT. UPON COMPLETION OF THE TRANSIT THE SCRN CDR DETACHES THE AIRSHIPS BY RADIO. NO NEW TASKS ARE INVOLVED IN DETACHMENT.

END SEGMENT 3 - ON STATION OPERATIONS.

APPENDIX C - TASK ANALYSIS FOR AMCM ON STATION OPERATIONS

A. FORMAT OF THE TASK ANALYSIS

1. Crewmember positions always appear first in each task descriptive statement. These are abbreviated as:

P = pilot

CN = communicator/navigator

CC = crew chief

CM1 = crewman nr. one

CM2 = crewman nr. two

CM3 = crewman nr. three

CM4 = crewman nr. four

2. If several (but not all) crewmembers are to perform a given task, then the letters indicating which are separated by a comma, as:

P,CN 0050 Monitor strain gauge.

If one or the other (but not necessarily both) are to perform a given item, then:

P/CN 0060 Acknowledge report.

COMMENCE SEGMENT 3 - ON STATION OPERATIONS

Crew-member	Task No.	Task Title
DESCEND FROM CRUISE ALTITUDE		
P	0010	Request controlling agency clearance to descend to 1,000 feet.
P	0020	Receive clearance.
P	0030	Alert crew on ICS/PA that airship will descend.
P	0040	Position airship to optimum descent angle.

P	0050	Commence leveling out when passing 2,000 feet (3 ship lengths above water).
P	0060	Level out at 1,000 feet, maintain 40 kts. speed.
P	0070	Report altitude to controlling agency.
P	0080	Receive acknowledgment.
P	0090	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
P	0100	Scan externally.

END DESCENT

SURVEY MINEFIELD AREA

P	0110	Maneuver AS to locate optimal locations for transponder drops (3 or more on land required).
	0120	NOTE: IF POSSIBLE, TRANSPONDERS MAY BE PLACED IN DESIRED POSITIONS BY FRIENDLY LAND FORCES PRIOR TO COMMENCEMENT OF AMCM OPERATIONS.
P	0130	Scan externally.
P/CN	0140	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.
P/cn	0150	Monitor fuel status.
P	0160	Maintain flight conditions.
CN	0170	Enter intended transponder locations on NAV DATA PLOTTER in grease pencil.

END SURVEY

DROP TRANSPONDERS

CN	0180	Guide P to location of transponder drop.
P	0190	Maneuver AS to proceed to location of transponder drop.
CN	0200	Alert crewman nr. 4 to stand by launcher chute.

CM4	0210	Acknowledge.
CN	0220	Order crewman nr. four to set radio transponder to desired freq and load launcher.
CM4	0230	Acknowledge freq setting.
CM4	0240	Set ordered freq in transponder.
CM4	0250	Load transponder into launcher chute.
CM4	0260	Report transponder loaded to CN.
CN	0270	Acknowledge transponder loaded.
CN	0280	When AS at desired point for transponder placement, inform P and req P to hover.
P	0290	Acknowledge in position.
P	0300	Shift from CRUISE to HOVER regime and hover AS over desired drop point.
P	0310	Verify area clear for drop.
P	0320	Activate transponder release switch.
CM4	0330	Report chute clear or transponder failed to release.
P/CN	0340	Acknowledge report.
CM4	0350	If transponder hung up in chute, release transponder manually.
P	0360	Observe transponder parachute open and report transponder on ground to CP.
CN	0370	When transponder on ground monitor Transponder Interrogation Transceiver (TIT) for proper transponder operation.
CN	0380	Report when receiving transponder transmissions to P.
P	0390	Acknowledge.
	0400	NOTE: IF TRANSPONDER FAILS TO OPERATE CORRECTLY, THE AS REMAINS IN HOVER OVER THE DROP POINT WHILE ANOTHER TRANSPONDER IS LAUNCHED. THIS IS REPEATED UNTIL A FUNCTIONING TRANSPONDER IS IN PLACE.

P	0410	Shift from HOVER to CRUISE regime.
CN	0420	Guide P to next desired drop point.
	0421	NOTE: THE TRANSPONDER DEPLOYMENT SEQUENCE IS REPEATED UNTIL THREE OR MORE SUCCESSFUL DROPS HAVE BEEN ACCOMPLISHED. THE PRECISE NUMBER OF TRANSPONDERS TO BE DROPPED WILL DEPEND UPON THE SIZE OF THE FIELD TO BE SWEPT. NAVIGATION ACCURACY DURING SWEEPING OPS REQUIRES THAT THE AS ALWAYS BE WITHIN A TRIANGLE FORMED BY THREE TRANSPONDERS. A MAXIMUM OF 10 BEACON FREQS ARE AVAILABLE.

END DROP TRANSPONDERS

TRANSPONDER CALIBRATION

CN	0430	Identify transponder numbers to AS nav system by entering numbers into CPC via CDP.
CN	0440	Identify sequence of baselines (lines between two adjacent transponders) to be crossed to nav system by entering data into CPC via CDP.
CN	0450	Inform P when ready to commence baseline crossings.
P	0460	Acknowledge.
P	0470	Verify electronic altimeter and doppler velocity radar altimeters operating correctly and outputs are being received by CPC.
P	0480	Set altitude desired (1,000 feet) into CPC via the CDP.
P	0490	Ensure actual altitude is 1,000 feet ± 50 feet.
P	0500	Engage altitude hold.
CN	0510	Give P course and speed to steer for first baseline crossing.
P	0520	Acknowledge course and speed and set in autopilot.
P	0530	Enable autopilot.

CN	0540	Monitor nav system status reports during baseline crossing.
CN	0550	When nav system indicates first baseline is crossed give P course to steer for second baseline crossing.
P	0560	Acknowledge new course and set in autopilot.
	0570	NOTE: THIS SEQUENCE IS REPEATED UNTIL EACH BASELINE (LINE BETWEEN TWO ADJACENT TRANSPONDERS) HAS BEEN CROSSED TWICE.
CN	0580	After last baseline crossing is completed, copy transponder locations as computed by nav system and order CPC to store transponder locations.
P	0590	Disengage autopilot and altitude hold.
CN	0600	Inform P transponder locations have been computed.
P	0610	Acknowledge report.

END TRANSPONDER CALIBRATION

DEPLOY SWEEP GEAR

P	0620	Order AMCM crew to man stations.
P,CN,CC	0630	Conduct ICS checks between P, CP, and AMCM crew chief.
P,CN	0640	Determine optimal sweep pattern.
CN	0650	Enter sweep leg parameters (start/stop points of track legs, course of each track, track length, distance between tracks, and number of tracks) into CPC via CDP.
CN	0660	Order CPC to display track leg coordinates.
CN	0670	Copy track leg coordinates and plot legs on NAV DATA PLOTTER.
P	0680	Maneuver AS to position clear for commencement of streaming operation.
P	0690	Request controlling agency clearance to descend to 50 feet.

P/CN	0700	Receive clearance.
P	0710	Alert crew on ICS/PA that airship will descend.
P	0720	Rotate AS to optimum descent angle.
P	0730	Level out at 50 feet. Slowly stop airship.
P	0740	Shift to HOVER regime.
P	0750	Report altitude to controlling agency.
P/CN	0760	Receive acknowledgment.
P	0770	Set altitude desired (50 feet) into CPC via CDP.
P	0780	Ensure actual altitude is 50 feet ± 5 feet.
P	0790	Engage altitude hold.
CC	0800	Man safety observer station; stand by winch. Attach gunner's belt.
CM1	0810	Man CM1 station. Attach gunner's belt.
CM2	0820	Man CM2 station. Attach gunner's belt.
CM3	0830	Man CM3 station. Attach gunner's belt.
CM4	0840	Man CM4 station. Attach gunner's belt.
CM1,CM2, CM3,CM4	0850	Connect to ICS.
P,CN,CC, CM1,CM2, CM3,CM4	0860	Check ICS comms.
CC	0870	Ready winch for operation.
CM1	0880	Check rear roller guide.
CM2	0890	Open rear hatch.
CM3	0900	Check front roller.
P/CN	0910	Monitor tow strain via CDP and alarm panel.
P	0920	Monitor flight status. Remain in hover at 50 feet while deploying first segment of sweep gear.

CC	0930	Monitor winch and cable for malfunctions. Act as safety observer.
CM4	0940	#4 crewman removes float from mounting, transfers float to #2 man.
CM2	0950	#2 crewman accepts and connects float to cable & deploys it.
CM4	0960	#4 crewman removes otter from mounting, transfers otter to #2 man.
CM2	0970	#2 crewman accepts and connects otter to cable and deploys it.
CM4	0980	#4 crewman removes cutter assembly from mounting and transfers it to #2 man.
CM2	0990	#2 crewman connects cutter to cable, arms it, deploys cable.
	1000	NOTE: TASKS 0980 AND 0990 ARE REPEATED UNTIL THREE CUTTERS ARE ATTACHED TO THE STBD WIRE.
CC	1010	Report to pilot that third cutter assy is attached and req P to hover at 75 foot altitude.
P	1020	Acknowledge report.
P	1030	Disengage altitude hold. Increase altitude to 75 feet. Set 75 foot altitude into CPC via CDP. Engage altitude hold.
P	1040	Inform CC AS at 75 foot altitude.
CC	1050	Acknowledge report.
CM4	1060	#4 crewman removes cutter assy from mounting and transfers it to #2 man.
CM2	1070	#2 crewman connects cutter to cable, arms it, deploys cable.
CC	1080	Report to P that fourth cutter assy is attached and req P to hover at 100 foot altitude.
P	1090	Acknowledge report.
P	1100	Disengage altitude hold. Increase altitude to 100 feet. Set 100 foot attitude into CPC vai CDP. Engage altitude hold.

P	1110	Inform CC AS at 100 foot altitude.
CC	1120	Acknowledge report.
CM4	1130	#4 crewman removes cutter assy from mounting and transfers it to #2 man.
CM2	1140	#2 crewman connects cutter to cable, arms it, deploys cable.
CC	1150	Report to P that fifth cutter assy is attached and req P to hover at 150 foot altitude.
P	1160	Acknowledge report.
P	1170	Disengage altitude hold. Increase altitude to 150 feet. Set 150 foot altitude into CPC via CDP. Engage altitude hold.
P	1180	Inform CC AS at 150 foot altitude.
CC	1190	Acknowledge report.
CM4	1200	#4 crewman removes cutter assy from mounting and transfers it to #2 man.
CM2	1210	#2 crewman connects cutter to cable, arms it, deploys cable.
CC	1220	Report to P that sixth cutter assy is attached and req P to move slowly ahead and descend to 50 feet.
P	1224	Energize stern zoom TV camera and display on monitor.
	1230	NOTE: OBJECT IS TO SLOWLY LOWER GEAR INTO WATER SO FIRST OTTER WILL CAUSE STBD WIRE TO BE DEPLOYED OUTWARD.
P	1240	Acknowledge report.
P	1250	Disengage altitude hold. Slowly increase forward motion to max 7 kts and slowly descend to 50 foot altitude.
P	1260	When at 50 foot altitude set 50 foot altitude into CPC via CDP. Engage altitude hold. Maintain approx. 7 kts forward speed.
P	1270	Inform CC AS at 50 foot altitude.

CC	1280	Acknowledge report.
CM4,CM2	1290	Continue sequence of removing cutter assemblies from mounting and attaching to stbd cable until 14 more assemblies are connected for a total of 20.
CM3	1300	#3 crewman remove float from mounting, transfers float to #1.
CM1	1310	#1 crewman accepts and connects float to cable and deploys it.
CM3	1320	#3 crewman removes otter from mounting, transfers otter to #1.
CM1	1330	#1 crewman accepts and connects otter to cable & deploys it.
CM3	1340	#3 crewman removes cutter assembly from mounting and transfers it to #1 man.
CM1	1350	#1 crewman connects cutter to cable, arms it, deploys cable.
	1360	NOTE: TASKS 1340 AND 1350 ARE REPEATED UNTIL THREE CUTTERS ARE ATTACHED TO THE PORT WIRE.
	1370	NOTE: TASKS 0940 THROUGH 1240 ARE PERFORMED BY P/CC/CM3/CM1 ON THE PORT WIRE IN THE SAME SEQUENCE AS WAS PERFORMED TO DEPLOY FIRST SEGMENT OF STBD SWEEP GEAR.
P	1380	Disengage altitude hold. Ascend to 75 feet altitude. Set 75 foot altitude into CPC via CDP. Engage altitude hold. Maintain approx. 7 kts forward speed.
CM4	1390	#4 crewman removes otter from mounting, transfers otter to #2 man.
CM2	1400	#2 crewman accepts and connects otter to cable and deploys it.
CM4	1410	#4 crewman removes float from mounting, transfers float to #2.
CM2	1420	#2 crewman accepts and connects float to cable & deploys it.
CM3	1430	#3 crewman removes otter from mounting, transfers otter to #1.

CM1	1440	#1 crewman accepts and connects otter to cable & deploys it.
CM3	1450	#3 crewman removes float from mounting, transfers float to #1.
CM1	1460	#1 crewman accepts and connects float to cable & deploys it.
P	1470	Navigate airship through area. Maintain 75 foot altitude.
P/CN	1480	Continue monitoring tow strain via CDP and alarm panel.
CM3,CM4	1490	Connect port sweep wire to stbd sweep wire.
CM3	1500	#3 crewman removes depressor from mounting transfers it to #1 man.
CM1	1510	#1 crewman accepts and connects depressor to cable deploys it.
CM4	1520	#4 crewman removes lead float from mounting; transfers float to #2.
CM2	1530	#2 crewman accepts and connects lead float to cable and deploys it.
CM1	1540	#1 crewman attaches locking ball to cable end.
CM2	1550	#2 crewman places lock ball in tow boom.
	1560	NOTE: GEAR IS NOW STREAMED AND SECURED FOR TOWING.
CC	1570	Crew chief retracts excess winch cable.
CC	1580	Crew chief informs pilot gear in tow.
P	1590	Acknowledge report.
CC	1600	Crew chief monitors gear in water for any problems.
CM1,CM2	1610	Station 2 man watch in airship door. Report to P and CN as each mine is cut and comes to surface.
	1020	NOTE: WATCH IS ROTATED BETWEEN MEMBERS OF THE AMCM CREW.

END DEPLOY SWEEP GEAR

SWEEPING OPS

P	1630	Disengage altitude hold. Ascend to 90 foot altitude. Set 90 foot altitude into CPC via CDP. Engage altitude hold. Mainrain 7 kts forward speed.
CN	1640	Req airship nav system to display course to steer to reach start point of first sweep leg.
CN	1650	Read course from CDP and inform P.
P	1660	Acknowledge and bring airship slowly to required course.
P	1670	When airship is in proximity of start point for first sweep leg bring airship slowly to proper heading for first sweep leg.
P	1680	Verify hand controllers in null position, ship control mode is PRIME and HOVER regime is selected (preparation for auto control by nav system).
P	1690	Depress auto track button on CDP.
P	1700	Monitor flight conditions while nav system conducts sweep navigation.
	1810	NOTE: CPC WILL DISPLAY ALARM IF BEACON RETURNS ARE INTERRUPTED.
P/CN	1720	When mine is reported on the surface by AMCM crew at stern door, inform OTC by radio comm.
	1730	NOTE: OTC WILL ORDER SECOND AIR PLATFORM TO SCENE TO DETONATE MINE BY GUNFIRE.
P/CN	1740	Receive acknowledgment.
P	1750	Monitor fuel status.
P	1760	Scan externally.
CN	1770	Monitor sweep ops progress on nav data plotter and on CDP.
P/CN	1780	Acknowledge and take action on computer generated alarms and computer generated equipment status reports.

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PERSONNEL AND EQUIPMENT DESIGN CONCEPT FOR A MARITIME PATROL AI--ETC(U)
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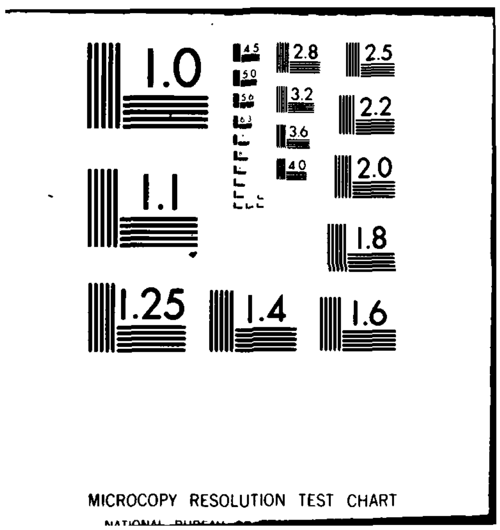
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MICROCOPY RESOLUTION TEST CHART

P	1790	Monitor flight conditions.
P	1800	When sweep ops completed, P depress auto search button on CDP to terminate auto nav.

END SWEEPING OPS

RECOVERY OF SWEEP GEAR

Recovery of the sweep gear is exactly the reverse of deployment. No new tasks are involved; and, therefore, the tasks will not be repeated here.

END RECOVERY

CLIMB TO CRUISE ALTITUDE

After recovery of the MK-103 AMCM gear the airship climbs to cruise altitude in preparation for return to base. The tasks involved are:

Crew-member	Task No.	Task Title
P	1810	Req designated control agency clearance to climb to 5,000 feet.
P	1820	Thrust up until airship is at 300 feet.
P	1830	Receive clearance.
P	1840	Shift from HOVER to CRUISE regime.
P	1850	Alert crew on ICS/PA that airship will climb.
P	1860	Rotate airship sufficiently to commence climb but exercise caution not to allow stern of airship to approach ocean surface closer than 75 feet.
P	1870	When clear of the ocean surface increase rotation to optimum ascent angle.
P	1880	Increase speed to 50 kts.
CN	1890	Enter present posit (lat/long) and posit of intended landing field (lat/long) in CPC via the CDP.

P	1900	Read heading to steer for intended landing field from CPC. Maintain this heading.
P	1910	Level out at 5,000 feet. Maintain speed of 50 kts.
CN	1920	Report altitude to designated control agency.
CN	1930	Receive acknowledgment.
P	1940	Acknowledge and take action on computer generated equipment status reports.
P	1950	Monitor fuel status.
P	1960	Scan externally.
P	1970	Maintain flight conditions.

END CLIMB TO CRUISE ALTITUDE

END SEGMENT 3 - ON STATION OPERATIONS

APPENDIX D

EQUIPMENT DESCRIPTIONS

Equipments will be listed in the same order in which they were listed in Chapter IV. Each equipment will be briefly described, and its weight in pounds will be given at the end of the description in parentheses. Sources for equipment weights and descriptions are: DSRV equipment [NAVSHIPS 0924-036-3010, 1976], P-3 equipment [NAVAIR 01-75PAC-1, 1977; Melendez, Note 3; Garretson, Note 4], IAIRTASS equipment [Phillips, 1974; Chesapeake Inst. Corp., 1972], Coast Guard equipment [Bailey, Note 5], and RH-53D equipment [NAVAIR 01-H53AAA-1, 1975].

A. BASELINE EQUIPMENTS

1. Pilot Station

a. Ship Control Group

(1) AUTO PILOT/DIGITAL DIFFERENTIAL ANALYZER. The Auto Pilot/Digital Differential Analyzer (AP/DDA) is used to provide prime auto-pilot computation for airship control. The AP/DDA has a variable program capability to solve iterative continuous real-time problems (48 lbs).

(2) SHIP CONTROL ELECTRONICS. The Ship Control Electronics interfaces command and data signals among the major equipments in the Ship Control Group as well as providing the analog backup mode electronics (26.0 lbs).

(3) GYRO SHELF ASSEMBLY. The Gyro Shelf Assembly consists of a Directional Gyro (DG), a Vertical Gyro (VG), two Rate Gyro Assemblies, and a Directional Gyro Slewing Control Assembly (22.0 lbs).

The DG is a two-degree-of-freedom instrument indicating vehicle motion in azimuth. It is used to provide alternate yaw attitude (heading) information to the ship-control equipment and the airship heading indicator.

The VG is a two-degree-freedom displacement gyroscope with a vertical reference and provides pitch and roll attitude information. The VG provides the prime source of coarse pitch and roll attitude data to be displayed to the operator, and is an alternate source of attitude data for use by the AP/DDA.

The Rate Gyro Assemblies, each containing a set of three rate gyros (one for each axis), measure the yaw, roll, and pitch rates of the airship. The redundant Rate Gyro Assembly is provided for use if the other set fails.

The DG Slewing Control Assembly provides a means for manually slewing and applying drift compensation to the Directional Gyro when the latter is being used to position the airship heading indicator.

(4) SHIP CONTROL MODE PANEL. The Ship Control Model Panel contains switches and indicators for the cruise and hover regimes, of vehicle motion, sensor reconfiguration, and mode reconfiguration. Also provided is a velocity latch switch, and a switch controlling interconnection of the Auto

Pilot/Digital Differential Analyzer and the Central Processing Computer (2.3 lbs).

(5) SHIP CONTROL PANEL. The Ship Control Panel contains the controls and displays necessary for the operation and control of the ballast, trim, list, and hydraulic power of the airship (19 lbs).

(6) STATE DISPLAY PANEL. The State Display Panel contains indicators which visually present ship velocities, attitudes, attitude rates, heading, vehicle altitude, range to target, and effector r/min (53.0 lbs).

(7) RUDDEVATOR ANGLE METER PANEL. The Ruddevator Angle Meter Panel contains two meters which indicate the pitch and yaw angles of the ruddevators (5.3 lbs).

(8) HAND CONTROLLER. The Hand Controller is a three-degree-of-freedom device which enables manual control of the airship. Since the airship has four degrees of freedom, two identical Hand Controllers are the complement; one controlling pitch and yaw, and the other controlling surge and heave. The net action of each Hand Controller is to transform the two possible motions of the hand grip (forward-back, twist left-twist right) into two sets of independent signals which control the motion of the airship (5.5 lbs).

(9) EMERGENCY SHIP CONTROL PANEL. The Emergency Ship Control Panel enables manual (on/off) control of the main engine,individual engines, and ruddevator of the airship during failure of higher level controls (4.2 lbs).

(10) COMPUTER CONTROL AND DISPLAY PANEL. The Computer Control and Display Panel is composed of a three-register numerical display, a film-viewer display encoder, illuminated pushbutton switches, and control buffering and storage logic. The three-register display, in combination with the film viewer and numerical keyboard, enables data to be entered into or displayed from the Central Processing Computer, by the operator (40.0 lbs).

(11) TOWING/SONAR ARRAY MONITOR PANEL. The Towing/Sonar Array Panel combines meters from the IAIRTASS system and new meters for the towing function to provide cable tension, cable footage, yaw angle, and tow speed indications (not available).

(12) TORPEDO FIRING PANEL. The Torpedo Firing Panel permits operator entry of torpedo run parameters into torpedoes and release of torpedoes (approximately 5 lbs).

b. Navigation System Group

(1) AN/ARN-187 DOPPLER VELOCITY RADAR ALTIMETER SET. The doppler velocity altimeter radar set (DVARS), AN/APN-187, is a frequency modulated, continuous wave radar which provides a visual indication of groundspeed, drift angle, and altitude of the aircraft. Velocities of the aircraft in the direction of heading, and of drift, are provided to the INS systems, as well as a status signal, Status, aircraft altitude (above terrain), drift distance, and heading distance are provided to the data analysis group (10.0 lbs).

(2) AN/APQ-107 RADAR ALTITUDE WARNING SET (RAWS). Two radar altitude warning systems (RAWS, AN/APQ-107) are designed to warn the pilot whenever the aircraft altitude drops below 380 feet altitude. The No. 1 RAWS receives input data from the radar altimeter and the No. 2 RAWS receivers input data from the DVARS. If aircraft radar-measured altitude becomes less than 380 (±20) feet, the RAWS actuates flashing red warning lights, and a 1000-cycle aural tone. Both warnings persist for 3 seconds. The aural tone is interrupted at a 2-cps rate and is applied through the ICS (regardless of ICS switch positions) to the pilot's headset and speaker (9.0 lbs).

(3) AN/APN-141(V) ELECTRONIC ALTIMETER SET. The radar altimeter, AN/APN-141 is a C-band, pulsed range-tracking, special purpose radar set. The altimeter provides reliable, continuous indication of aircraft height above land or water, in the range of 10 to 5000 feet with accuracy of ±5 feet or ±5%, whichever is greater. Dropout altitude is 5000 feet. The system consists of an indicator and associated low altitude warning lights (9.0 lbs).

(4) TRANSPONDER RELEASE PANEL. The Transponder Release Panel contains Transponder release control switches (3.3 lbs).

(5) AN/ARN-83 DIRECTION FINDER SET. The AN/ARN-83 low-frequency automatic direction finder (ADF) is used for routine point-to-point ratio navigation. The ADF receiver operates on am signals, in the 190 to 1750 KHz frequency range.

When in use, the system provides visual bearing indications to ground radio beacons and commercial broadcasting stations. The equipment can also be operated manually, enabling the pilot to navigate by locating the null direction of the loop antenna. In either mode, aural reception of the tuned-in station is available to the intercom system. The system comprises a loop antenna, a fixed reference antenna, an ADF receiver, and a control panel (10.0 lbs).

(6) AN/ARN-54(V) TACAN NAVIGATION SET. The tactical air navigation (TACAN) radio set, AN/ARN-52 is an airborne interrogated-responder, designed to operate in conjunction with an appropriate surface beacon for navigation purposes. The airborne and surface equipment form a radio navigation system which enables the aircraft to obtain continuous indications of distance and bearing from the selected surface beacon located within 300 nm or line-of-sight distance (whichever is less) from the aircraft. Distance information is determined by the elapsed time of round-trip travel of the radio pulse signals between the aircraft and surface station. Timing circuits in the TACAN receiver automatically measure the elapsed time interval and convert this time into nautical miles. Bearing from the aircraft to the surface station is provided by the station transmitting a reference bearing signal and a variable bearing signal which are received by the TACAN receiver, phase-measured, and then converted into an azimuth indication in degrees (45.0 lbs).

(7) ILS - INSTRUMENT LANDING SYSTEM. The instrument landing system (ILS) receiving equipment is provided to enable the pilot to make precision approaches during low visibility conditions to airfields having ground ILS equipment. The aircraft equipment comprises a standard 329.3 to 335.0 MHz UHF glideslope receiver, 51V-4, with an antenna located in the nose radome (5.0 lbs).

c. Object Location and Recording Group

(1) TV MONITOR. The TV Monitor is an operator-controlled monitor which displays the images received by the external television cameras. Each monitor can be manually selected to control one of two preselected TV Cameras. Each monitor provides all TV camera controls (18.5 lbs).

(2) EXTERNAL FLOODLIGHTS CONTROL PANEL. The External Floodlights Control Panel contains on/off switches which control all external floodlights. Each floodlight circuit is protected by fuses within the panel (9.5 lbs).

(3) FILM CAMERA CONTROL PANEL. The Film Camera Control Panel contains the on/off reset and trigger controls for the Still Camera. Controls are also provided for an additional Still Camera and a motion picture camera when these are added for alternate missions (8.2 lbs).

(4) AN/APS-127 FORWARD LOOKING RADAR (FLAR). The APS-127 FLAR is a forward-looking search radar with a nose-mounted antenna having azimuth scan limits of ±120°. It is capable of detecting targets on the sea surface under the average assumed condition of sea state 3. This performance

is achievable under conditions of day, night, haze, fog, clouds or light precipitation. Although the single look probability of detection is 0.5, the radar's 10-second scan time results in multiple looks at real targets. Thus, for average expected operational conditions, it can be assumed that the single look performance is equivalent to 0.90 probability of target detection (separate display panel weight not available; total system weight 296.0 lbs).

(5) ACTIVE-GATED TELEVISION/LASER ILLUMINATION. The active-gated television is operated in conjunction with a LASER illuminator in order to gain energy reflection from targets. It is capable of providing imagery (including hard copy) of targets, including names and numbers of ships. Thus, functional capabilities are to document illegal activity and identity of violators. The AGTV is not a search device and cannot effectively scan to encompass targets outside its field of view. However, a limited capability exists for obtaining a record of oil sheens where the sheen size is sufficiently small to be accommodated within the field of view, or in cases where an oblique view would be adequate.

Capabilities of the AGTV to obtain imagery of violators exist both day and night, in clear weather only. Probability of success for these functions is estimated to be 0.95. For obtaining sheen records, performance is limited to day clear weather and the relatively low capability is represented by a probability of success of 0.20 (separate display panel weight not available; total system weight 208.0 lbs).

d. Communication Group

(1) COMM PANEL (COMPOSED OF)

(a) ICS. The Interior Communications Set provides communication between the crew stations and externally to ground crew personnel during launch and landing (59.0 lbs).

(b) ECS. The Exterior Communications Set provides communications externally through hull mounted loud-speakers to surface vessels or personnel in the water (weight not available).

(c) UHF CHANNEL SELECT. No explanation required (36.0 lbs).

(d) HF CHANNEL SELECT. No explanation required (75.0 lbs).

(e) UWT (UNDER WATER TELEPHONE). The UWT provides voice or CW communication between the airship and a friendly submarine. The transducer head is lowered by line from the airship into the water and recovered after communi-cations are completed (approximate weight 40.0 lbs).

(f) CRYPTO (SECURE VOICE). The KY-28 equipment permits covered voice transmissions and receptions (19.0 lbs).

(g) VHF CHANNEL SELECT. No explanation required (20.0 lbs).

(h) IFF. The AIMS (Air traffic control radar beacon system/IFF/Mark XII identification system/System)

transponder system is capable of automatically reporting coded identification and altitude signals in response to interrogations from surface (or airborne) traffic, and maintain vertical separation (15.0 lbs).

e. Emergency Equipment Group

(1) ALARM PANEL. The Alarm Panel provides visual information of warning, caution, and status conditions (13.3 lbs).

(2) EMERGENCY JETTISON PANEL. The Emergency Jettison Panel contains the switches which control power for jettison of selected subsystem equipment of the airship in emergency situations. This panel also contains two cautions for the Alarm Panel. Included among the subsystems capable of being jettisoned are the tow cables for the IAIRTASS, the towing winch, and the AMCM sweeping gear (7.6 lbs).

(3) FIRE EXTINGUISHER CONTROL PANEL. The Fire Extinguisher Control Panel provides the capability to extinguish fires in the engines (weight not available).

(4) AN/ALR-54 ESM. The Electronic Surveillance Measures set dipslays a threat identification window identifying a specific hostile emitter when detected. The ALR-54 also triggers the alarm panel. In addition it provides the pilot with the bearing of the emission (approximately 20 lbs).

f. Engine Control/Power Distribution Group

(1) AUXILIARY POWER UNIT (APU) CONTROL PANEL. The APU Control Panel controls the operation and monitors

the output of the auxiliary power unit, which provides electrical power when the main engines are not operating (2.4 lbs).

(2) ENGINE CONTROL AND MONITORING PANEL. The Engine Control and Monitoring Panel enables the pilot to control the operation of the main engines and to monitor their operating parameters. In addition to the displays on the Engine Control and Monitoring Panel, all engine operating parameters are also monitored by the CPC (20.5 lbs).

(3) ELECTRIC POWER SYSTEM CONTROL PANEL. The Electric Power System Control Panel consists of circuit breakers and switches which control the main power circuits for the airship (22.7 lbs).

(4) LIGHTING CONTROL PANEL. The Lighting Control Panel consists of switches which control the main interior lighting circuits for the airship (12.5 lbs).

(5) CONTROL AND DISPLAY LIGHTING CONTROL PANEL. The Control and Display Lighting Control Panel controls the illumination level of the control and display panels and meters (7.0 lbs).

g. Environmental Control System

(1) AIR CONDITIONING CONTROL PANEL. The Air Conditioning Control Panel consists of switches and level controls for cooling and heating the interior of the control car as well as de-icing of exterior surfaces (approximately 26.0 lbs).

2. Communicator/Navigator Station

a. Navigation System Group

(1) INERTIAL, LORAN, AND "OTHER." This group of equipment has been identified by the Coast Guard for inclusion on the Maritime Patrol Airship. No specific description is available. The weight given for the total package is (52.3 lbs).

(2) CENTRAL PROCESSING COMPUTER. The Central Processing Computer (CPC) is a combination of a digital differential analyzer and a general purpose computer, and performs all the computations required in the navigation function. This combination is used to provide the great variety of processing operations required by the subsystem. The digital differential analyzer section is used to solve highly iterative, continuous, real-time computations for navigator control pruposes. The general purpose section is used to solve low iterative, random-time computations and provides decision functions, interface servicing, and solutions to the navigation problem depending on the navigation mechanization selected.

In addition to the digital differential analyzer and general purpose sections, the Central Processing Computer also contains an input-output section and a power supply (86.1 lbs).

(3) STANDBY HEATER CONTROL ASSEMBLY. The Standby Heater Control Assembly in conjunction with the Inertial

Navigator Binnacle thermostat controls the Standby Heater power which is used to raise and maintain temperatures of the Inertial Navigator Binnacle for the purpose of minimizing equipment warm-up time (0.6 lbs).

(4) COMPUTER CONTROL AND DISPLAY PANEL. This is described under the Pilot's Station.

(5) COMPUTER RECORDER-REPRODUCER. The Computer Recorder-Reproducer is a seven-channel, single-speed digital magnetic tape recorder used to load the various computer programs into the Central Processing Computer (17.5 lbs).

(6) COMPUTER PROGRAM TAPE. The Computer Program Tape is a magnetically programmed mylar tape which provides the programs required to enable the CPC to fulfill the data processing and special purpose functions. The tape contains the AP/DDA computer program (0.75 lbs).

(7) MAGNETIC TAPE STORAGE BIN. The Magnetic Tape Storage Bin is a magnetically shielded bin used for storage of magnetic tape (9.5 lbs).

(8) AN/APQ-107 RADAR ALTITUDE WARNING SET (RAWS). This is described under the Pilot's Station.

(9) AN/APN-141(V) ELECTRONIC ALTIMETER SET. This is described under the Pilot's Station.

(10) AN/APN-187 DOPPLER VELOCITY RADAR ALTIMETER SET. This is described under the Pilot's Station.

(11) TRANSPONDER INTERROGATION TRANSCEIVER. The function of the Transponder Interrogation Transceiver is to interrogate radio beacons dropped by the airship during

minesweeping operations thereby providing slant range information from a minimum of three transponder beacons. The slant range is processed by the CPC to determine the position of the airship with respect to the beacon net (21.8 lbs).

(12) STATE DISPLAY PANEL/HSI. This is described under the Pilot's Station.

(13) NAVIGATION DATA PLOTTER. The Navigation Data Plotter presents a visual display to the operator of the airship position in the horizontal plane. The Navigation Data Plotter operates directly on commands from the Central Processing Computer and plots a permanent trace of the airship range and track relative to the starting point (24.0 lbs).

(14) BAROMETRIC ALTIMETER. The barometric altimeter provides airship altitude information as determined from ambient atmospheric pressure (approximately 5.0 lbs).

(15) CLOCK. No explanation required (approximately 5.0 lbs).

(16) NAVSAT. The Satellite Navigation set provides highly accurate fix information obtained from orbiting navigation satellites. The airship's navigation position is automatically updated and displayed at each satellite pass (weight not available).

(17) OMEGA. Omega navigation set AN/ARN-99(V) processes transmitted omega signals, providing the operator continuously updated navigational data during flight regardless of time of day or climatic conditions. Omega navigation is a VLF Navigation system employing strategically located

transmitters around the world. Each station transmits bursts of three different frequencies multiplexed so that any frequency is transmitted by only one station at a time. The airborne receiver synchronizes to the broadcast pattern and measures the phase relationship to each available station from the receiver's location. This phase measurement is then provided to the central computer where a circular distance is computed to each station. These distances are combined with a current DR position to compute the omega fix position. This fix position is recomputed every 10 seconds as long as accurate omega information is received (weight not available).

(18) AN/ARN-83 DIRECTION FINDER SET. This is described under the Pilot's Station.

(19) AN/ARN-52(V) TACAN NAVIGATION SET. This is described under the Pilot's Station.

b. Object Location and Recording Group

(1) TV MONITOR. This is described under the Pilot's Station.

(2) TV CAMERA SELECT UNIT. The TV Camera Select Unit contains the relay switching necessary to control the interfacing of two television cameras and two television monitors. The unit routes signals controlling television camera selection and control (16.5 lbs).

(3) CONTROL AND DISPLAY POWER SUPPLY. The Control and Display Power Supply provides voltage regulated power to

the sensors and alarm system, and constant current power to the two TV cameras (27.0 lbs).

(4) AN/APS-127 FORWARD LOOKING RADAR (FLAR). This is described under the Pilot's Station.

(5) AN/APS-94 SIDE LOOKING RADAR (SLAR). The AN/APS-94 SLAR is a side-looking radar capable of detecting and mapping ship targets and oil sheens on the sea surface (oil in winds greater than 3 knots). Lateral field of view extends down to 45 degrees from the vertical on either side of the airship and thus does not include a ±45 degrees azimuth segment below the airship (weight not available).

(6) IR/UV LINE SCANNER (SCANNER). The IR/UV line scanner is capable of detecting and mapping targets including oil sheens. It functions by detecting differences in energy radiation between sheens or other targets and surrounding water areas. It is oriented to scan laterally through the nadir, with angular coverage of ±60°. Thus it covers the area below the MRS aircraft outside the SLAR scan limits (235.0 lbs).

(7) AUTOMATIC DATA ANNOTATION SYSTEM (ADAS). The Automatic Data Annotation System provides a functional capability for imprinting data on records from the SLAR, SCANNER, AGTV and camera (28.0 lbs).

c. Communication Group

(1) INTERIOR COMMUNICATION SET. This is described under the Pilot's Station.

(2) UHF RADIOS. No explanation required.

(3) HF RADIOS. No explanation required.

(4) VHF RADIOS. No explanation required.

(5) UNDER WATER TELEPHONE. This is described under the Pilot's Station.

(6) SPEECH AND DATA RECORDER SET. The Speech and Data Recorder provides a permanent record (on magnetic tape) of speech and data signals on the airship during an entire mission. It is a seven-track recorder with five tracks allocated to recording internal and external communications, one track allocated to recording digital data from the Central Processing Computer, and one track for recording the IRIG-B time code generated by the Central Processing Computer (32.5 lbs).

(7) IFF. This is described under the Pilot's Station.

d. Emergency Equipment Group

(1) ALARM PANEL. This is described under the Pilot's Station.

e. Power Distribution Group

(1) RACK EQUIPMENT POWER SWITCHING PANEL. The Rack Equipment Power Switching Panel provides controlled power for sensor and ship-control equipment (54.3 lbs).

(2) CONTROL AND DISPLAY POWER SWITCHING PANEL. The Control and Display Power Switching Panel contains the controls necessary to provide switching and protection of power to the control and display equipment of the airship (72.0 lbs).

(3) SENSOR PROTECTION PANEL. The Sensor Protection Panel provides a central location for the fuses which protect various external sensors of the ship-control and life-support functions (3.3 lbs).

(4) AC LIGHTING POWER SUPPLY. The AC Lighting Power Supply consists of five transformers, each of which furnishes a 5-V 400-Hz output for panel lighting. Each transformer requires a 115-V 400-Hz input (2.6 lbs).

(5) DC LIGHTING POWER SUPPLY. The DC Lighting Power Supply is a transformer and dc supply which furnishes 5-V 400-Hz and rectified a +5-Vdc outputs which are used for panel lighting. It requires a 115-V 400-Hz input (2.6 lbs).

f. Environmental Control System (ECS)

(1) AIR CONDITIONING CONTROL PANEL. This is described under the Pilot's Station.

(2) EQUIPMENT COOLANT GROUP. The Equipment Coolant Group, consisting of a liquid coolant unit, a hull heat exchanger, temperature transducers, manifolds, tubing, and miscellaneous hose assemblies, circulates an inhibited ethylene-glycol/water mixture through the Inertial Navigator, the Auto Pilot/Digital Differential Analyzer, and the Central Processing Computer. The heat removed is transferred to another cooling system, or to the vehicle hull by means of heat exchangers (78.5 lbs).

3. Aft Crew Station

(1) INTERCOMMUNICATIONS PANEL. The Intercommunications Panel provides communications internal to the airship (10.0 lbs).

(2) ECS (EXTERIOR COMMUNICATIONS SET). The ECS provides the capability for the aft crewman to utilize the exterior loudspeakers to communicate with a surface vessel or personnel in the water (weight not available).

(3) AIR CONDITIONING CONTROL PANEL. The Air Conditioning Control Panel provides temperature control capability for the Aft Crew Station (25.8 lbs).

(4) ZODIAC BOAT AND BOAT WINCH. The Zodiac boat is a rubber small boat with attached outboard motor. The winch provides launch/recovery capability (500.0 lbs).

(5) PERSONNEL RECOVERY WINCH. The Personnel Recovery Winch provides the capability to lift personnel up into the airship (84.0 lbs).

(6) TOWING WINCH AND WINCH CONTROL AND MONITOR PANEL. The Towing Winch and Control and Monitor Panel provide the capability to tow a small surface vessel. Included are guillotine devices and automatic tension release mechanisms (weight not available).

(7) LAUNCHER CHUTE. The Launcher Chute provides a means to drop radio transponders and bathythermograph devices from the airship (5.2 lbs).

(8) LIGHTING CONTROL PANEL. The Lighting Control Panel provides the capability to control cabin lighting at the Aft Crew Station (12.5 lbs).

(9) TRANSFER BALLAST PUMP AND HOSE. The Transfer Ballast Pump and Hose enables the airship to take on salt water ballast from the ocean. The hose is flexible, about 150 feet long with a fiberglass scoop in the end. About 25 feet up from the scoop is a streamlined cylinder containing an electric pump (115.0 lbs).

(10) IN-FLIGHT REFUELING CONNECTION AND STOP VALVE. This is a quick disconnect fitting into which is mated a fueling hose provided by a surface vessel to conduct in-flight refueling (weight not available).

(11) *UWT HYDROPHONE AND CABLE. The UWT Hydrophone* and Cable are lowered from the airship into the ocean when conducting UWT communications with a submarine (approximate weight 20.0 lbs).

4. <u>Hull Mounted Equipment</u>

(1) STERN ZOOM TELEVISION CAMERA. The Stern Zoom Television Camera provides remote observations of objects and activities aft of the airship when used in conjunction with the TV Monitors. The Stern Camera is used primarily to view the tow line and towed vessel during towing operations and to view the sweep gear during Airborne Mine Countermeasures operations (approximate weight 17.0 lbs).

(2) RESCUE HATCH ZOOM TELEVISION CAMERA. The Rescue Hatch Zoom Television Camera provides remote observation of objects and activities under the airship when used in conjunction with the TV Monitors. The Rescue Hatch Camera is used primarily to view personnel in the water during SAR operations.

(3) ACTIVE GATED TELEVISION/LASER ILLUMINATION. This is described under the Pilot's Station.

(4) UNDERSIDE EXTERNAL FLOODLIGHTS. The Underside External Floodlights provide illumination for night operations. Two will be located amidships and two aft (8.0 lbs. each).

(5) KS-87 AERIAL CAMERA. The KS-87 Aerial Camera can be indexed to look either straight downward or laterally 30° down from horizontal. Interchangeable lenses permit response to differing photography requirements. Functional capabilities are to document illegal activity (such as in fisheries), document identity of violators through obtaining photographs including ship names and numbers, and document presence of oil sheens. These capabilities exist only in clear daylight under good lighting conditions.

(6) UNDERSIDE EXTERNAL LOUDSPEAKERS. The Underside External Loudspeakers are part of the External Communications System described under the Pilot's Station (10.0 lbs. each).

(7) AN/APS-127 FORWARD LOOKING RADAR (FLAR). The FLAR is described under the Pilot's Station.

(8) AN/APS-94 SIDE LOOKING RADAR (SLAR). The SLAR is described under the Communicator/Navigator's Station.

B. SAR (COAST GUARD) EQUIPMENTS

1. Aft Crew Station

a. Portable Damage Control Equipment. No explanation required.

b. Rescue Basket. The Rescue Basket is used by the Coast Guard for SAR vice the "horse collar" sling used by the Navy.

C. ASW EQUIPMENTS

1. Pilot Station

a. Bearing Time Recorder (BTR). The purpose of the Bearing Time Recorder is to display a bearing-time history of the broadband energy detected by the sonar array. The presence and bearing of a target are indicated by a line drawn on heat sensitive rolling paper drawn down the face of the BTR. Actual recording is in full view of the operator and is visible at the point of recording on the paper. The paper passes over a large, firm, flat surface for chart notations. Bearings are determined using a built in sliding optical cursor. Target bearing is read directly from the cursor (separate weight not available).

b. Environmental Display Panel. The Environmental Display Panel contains displays for: water temperature at the array, depth, heading, and speed of the array (separate weight not available).

2. Communicator/Navigator Station

a. Bearing Time Recorder BTR. This is a duplicate of the BTR at the Pilot's Station.

b. Environmental Display Panel. This is a duplicate of the Environmental Display Panel at the Pilot's Station.

c. AN/ASQ-81 MAD (Magnetic Anomaly Detection). The MAD is utilized at low altitude to detect submarines measuring changes (anomalies) in the normal earth's magnetic field caused by the presence of the metal mass of a submarine. Controls are provided both to operate the avionics and to deploy and recover the towed detector head on a cable astern of the airship. The cable and detector head are winched in or out with an electric winch (weight not available).

3. ASW Sensor Operator Station

a. IAIRTASS (Interim Airborne Towed Array Sonar System). The IAIRTASS is described in the ASW Scenario contained in Chapter III and will not be repeated here. Weights for system components are:

Sonar System	
Avionics console (includes processors)	845
Array assembly	1100
Cable	330
Subtotal	2275
Mechanical Handling System (estimated)	
Winch drum and frame	330
Guide sheave and level wind	200

Swivel fairlead	100
Aircraft support structure	120
Subtotal	750
Supplementary Equipment	
Tape recorder	85
Data relay	50
Subtotal	135
Total IAIRTASS Payload	3160

b. Recorder-Reproducer. The Recorder-Reproducer provides the capability to record six direct (analog) and 36 FM data channels. Voice data annotation can also be recorded (weight given with IAIRTASS).

c. Data Relay. The Data Relay AN/ARC-52 radio set provides the capability to data link the signals recorded on the Recorder-Reproducer (weight given with IAIRTASS).

d. MK-46 Torpedoes. No explanation required (600 lbs. each).

e. AN/SSQ-36 Bathythermograph. The AN/SSQ-36 bathythermograph and ambient sea noise meter system are components of the ASW acoustic sensor system. The system interfaces with the ARR-72 sonobuoy receiver system. For the BT, rf input signals, received by the sonobuoy receiver system, are converted into ocean water temperature gradient information. This temperature information is available as a

visual graphic presentation (strip chart recording) and a digital output. The visual presentation provides a permanent chart record of the temperature profile (temperature versus depth) of the ocean area being probed (10.0 lbs).

D. AMCM EQUIPMENTS

1. Aft Crew Station

a. Beacon Transponders. The Beacon Transponders are launched through the Launcher Chute from the airship and operate in conjunction with the Transponder Interrogation Transceiver described under the Communicator/Navigator Station (Nominal weight 20 lbs).

b. MK 103 AMCM Minesweeping Kit. The MK 103 AMCM Minesweeping Kit is a pre-packaged kit containing all of the elements required for airborne mine countermeasures operations. Although designed for use by the RH-53D helicopter, it would be readily adaptable for use by an airship (3,111.0 lbs).

LIST OF REFERENCES

Allen, H., The Story of the Airship (Non-Rigid). Chicago: Lakeside Press, 1943.

American Institute of Aeronautics and Astronautics. Lighter-Than-Air Systems Technology Conference, 2d, 1977 - A Collection of Technical Papers. New York: AIAA, 1977.

American Institute of Aeronautics and Astronautics. Lighter-Than-Air Systems Technology Conference 3d, 1979 - A Collection of Technical Papers. New York: AIAA, 1979.

Browning, R.F.; Lauber, J.K.; and Scott, P.G. Task Analysis of Pilot, Copilot, and Flight Engineer Positions for the P-3 Aircraft (TAEG Report No. 7). Orlando, FL: Naval Training Equipment Center, 1973. (NTIS No. AD-766 455).

Channell, R.C. Human Factors in the Design of Airships - Technical Report SDC 641-2-9. New York: Dunlap and Associates, Inc., 1950.

Chesapeake Inst. Corp., Operator's Instructions Part of Technical Manual for Interim Airborne Towed Array Sonar System. Shadyside, Maryland: Chesapeake Instrument Corp., 1972.

Clarke, B. The History of Airships. New York: St. Martin's Press, 1961.

Commanding Officer, U.S. Naval Development Unit (Project Lincoln) letter FF12/NADU/P60: nat F24 serial 043 to Chief of Naval Research, Subject: Special Report on Extended Flight of ZPG-2, Bu. No. 141561; Submission of, 25 September 1957.

Flanigan, R.J. Preliminary Calculations for an ASW Airship, M.S. Thesis, Naval Postgraduate School, 1978.

Gear, C.W. D180-19476-1 Analyst's Guide for the Analysis Sections of MIL-H-46855, Report to the Human Factors Engineering Division, Crew Systems Department, Naval Air Development Center, Warminster, PA 18974. Seattle, WA: Boeing Aerospace Co., 1976.

Glover, R.P. A Conceptual Design of a Lighter-Than-Air Test and Research Vehicle, M.S. Thesis, Naval Postgraduate School, 1979.

Goodyear Aerospace Corporation Report Nr. 7805-60, Maritime Patrol Airship Design Study Concept - ZP3G, Prepared for Naval Air Development Center, 1 April 1979.

Malone, T.B.; Gloss, D.S.; and Eberhard, J.W. Human Factors Techniques Employed in Deriving Personnel Requirements in Weapon System Development. Report Nr. PRR68-3 to the New Developments Research Branch, Bureau of Naval Personnel. Alexandria, VA: The Matrix Corporation, 1967.

MIL SPEC MIL-H-46855B. Military Specification - Human Engineering Requirements for Military Systems, Equipment and Facilities, 31 January 1979.

Naval Air Systems Command, NAVAIR 01-H53AAA-1. NATOPS Flight Manual Navy Model RH-53D Helicopter. Washington, D.C.: Office of the Chief of Naval Operations, August 1975.

Naval Air Systems Command, NAVAIR 01-75PAC-1. NATOPS Flight Manual P-3C Aircraft. Washington, D.C.: Office of the Chief of Naval Operations, June 1977.

Naval Sea Systems Command, NAVSHIPS 0924-036-3010. Technical Manual for Deep Submergence Rescue Vehicle Sensors and Controls Subsystem Volume I of VI. Washington, D.C.: Department of the Navy Deep Submergence Systems Project Office, 1976.

Nayler, A.W.L. British Lighter-Than-Air Activity: A Review. AIAA Lighter-Than-Air System Technology Conference, 3d, 1979, pp. 49-51.

OMB A-109, Office of Management and Budget Circular A-109, Subject: Major System Acquisitions. Washington, D.C.: April 5, 1976.

Phillips, C.C. NADC-74048-20. Mechanical Handling Tests Interim Airborne Towed Array Sonar System. Warminster, PA: Naval Air Development Center, 1974.

U.S. Congress. Senate, Committee on Commerce, Science and Transportation. NASA Authorization for Fiscal Year 1980 Report No. 96-207, Report of the Committee on H.R. 1786, Senate, 96th Cong., 1st Session, June 11, 1979.

U.S. Congress. Senate, Committee on Commerce, Science and Transportation, Propelled Lighter-Than-Air Vehicles. Hearings before a subcommittee on Commerce, Science, and Transportation. Senate, 86th Cong., 1st Session, 1979.

Van Cott, H.P. and Kinkade, R.G. (Ed.). Human Engineering Guide to Equipment Design. Washington, D.C.: Government Printing Office, 1972.

Vittek, J.F., Jr. (Ed.). Proceedings of the Inter-Agency Workshop on Lighter Than Air Vehicles, M.I.T. FTL Report R75-2, Cambridge, Mass: Massachusetts Institute of Technology, 1975.

REFERENCE NOTES

1. Eppes, M.H., excerpt from untitled paper presented at Naval War College and quoted in Clarke, B., The History of Airships. New York: St. Martin's Press, p. 174, 1961.

2. Rappaport, H.K. Estimated Life Cycle Costs and Logistics Technical Memorandum No. 79-13 Preliminary Draft prepared for Office of Naval Research, Arlington, VA., 6 September 1979.

3. Melendez, Code 425, Naval Air Rework Facility, Alameda, California, personal communication, December, 1979.

4. Garretson, D., Lockheed Aircraft Company, Burbank Facility, personal communication, December, 1979.

5. Bailey, D.B., Code 605B, Naval Air Development Center, Warminster, PA., personal communication, October, 1979.

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